Alberta
ENVIRONMENTAL CENTRE

85-1871/

Alberta

GOVERNMENT OF ALBERTA

Front cover: False color, infra-red photo of the Alberta Environmental Centre at a scale of 1:25,000.

ALBERTA ENVIRONMENTAL CENTRE
ANNUAL REVIEW
1983-84

ALBERTA ENVIRONMENTAL CENTRE
VEGREVILLE, ALBERTA

AECV84-AR2
ISSN 0715-6634
September 1984

This Report May Be Cited As:
Alberta Environmental Centre. Annual Review 1983-84.
Vegreville, Alberta. September, 1984.
44p. AECV84-AR2.

CONTENTS

Introduction	4
Analytical, Diagnostic, Extension and Technical Services	7
Pest Management Research and Development	15
Water/Wastewater Management Research and Development	19
Environmental Toxicology	22
Living Natural Resources	25
Waste Management Research and Development	28
Land Resources Management Research and Development	30
Administrative Support	32
Alberta Environmental Centre Programs/Projects	35
Staff Roster	37
Staff Committee Memberships	39
Journal Articles	40
Other Publications	41
Board of Directors	43
Technical Advisory Committee	43
1983-84 Fiscal Year Expenditures	44
Organization Chart	

INTRODUCTION

The Alberta Environmental Centre undertook the study and solution of environmental problems in over 45 Programs and 120 individual Projects in the fiscal year ending March 31, 1984. Though centred in Vegreville, the work took staff to all corners of Alberta gathering information on topics ranging from the chemical content of drinking water to the population characteristics of Bertha armyworms. This work was carried out for various departments and agencies of the Government of Alberta, in fulfillment of the Centre's mandate to act as the province's central agency providing environmental services, research and technical development.

The Alberta Environmental Centre in Vegreville is the central agency for Provincial Government environmental work.

The end of the 1983-84 fiscal year marked nearly three years since the Alberta Environmental Centre was opened, and four and a half years since the first staff transferred to the main laboratory building in Vegreville, 100 km east of Edmonton.

During those years, efforts were concentrated on bringing together the people and facilities required to carry out the Centre's broad mandate of studying and solving environmental problems identified by Provincial Government departments and agencies.

The heart of the physical facility is the 17,000 square-metre main laboratory building comprising five Wings - Common Services, Chemistry, Animal Sciences, Plant Sciences and Environmental Technology. The 750-acre (300-hectare) site also accommodates a 3,000 square-metre Services Building, an interim laboratory waste treatment system and four waste storage lagoons. Much of the land is used for agricultural plot experiments, while shelterbelts, animal holding facilities and land reclamation plots are among the other uses.

In 1983-84, with most staff and facilities in place, work increasingly concentrated on addressing practical problems within the general areas of client services, environmental research and technical development. Some new activities, most notably in the area of land reclamation, were started in response to the requests of client departments and agencies. Other work entered a wind-down phase during the year, as in the case of studies of chemical residues in fish where experimental results were supplied to provincial fisheries personnel for use in managing Alberta's aquatic resources.

Several new projects were started after going through an approval process designed to ensure the timeliness, relevance and completeness of the proposal. In this process, a Technical Advisory Committee (TAC) of client agencies' senior technical staff made project proposals to the Centre. After Centre staff review, the proposals went back to the TAC for comments from client agencies. The TAC then sent the proposals to the Centre Board of Directors (made up of Deputy Ministers or equivalent from client departments, and the Centre's Executive Director). The Board then sent its recommendations to the Minister of Alberta Environment.

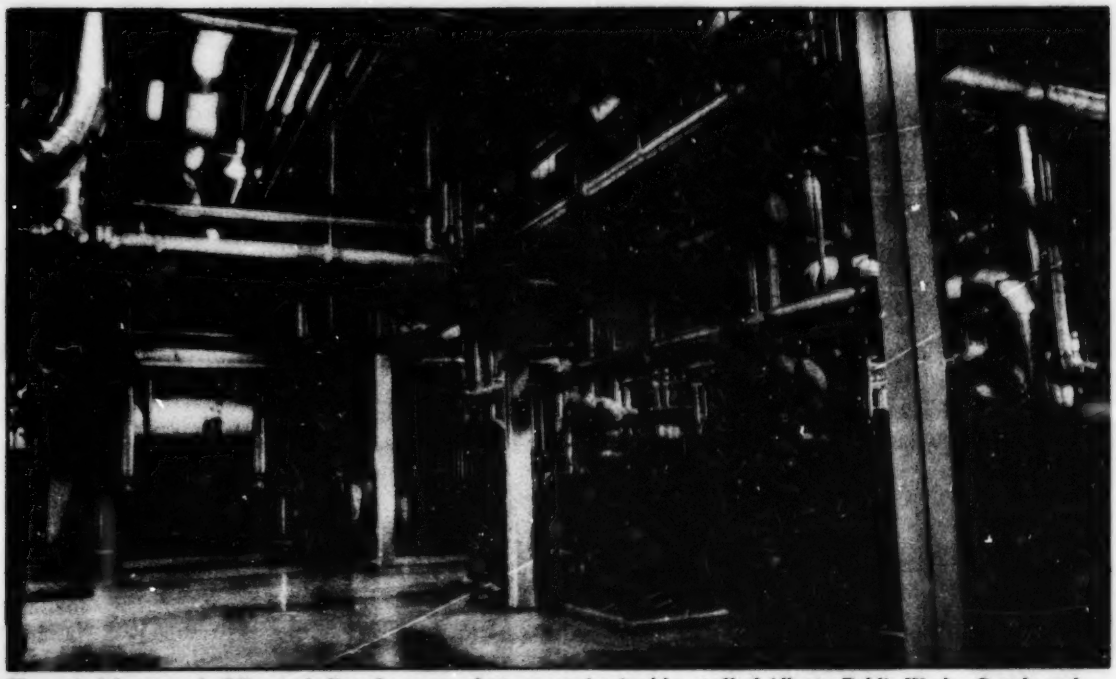
Work was carried out for six major client agencies during the fiscal year: the Alberta Research Council; provincial Health Units; and the Departments of Energy and Natural Resources, Agriculture, Environment and Workers' Health, Safety and Compensation.

Alberta Agriculture was the major client for work carried out by the Plant Sciences Wing. Most work carried out for this Department was in weed, plant disease and insect management. Programs carried out for Alberta Environment ranged from studies on pollution abatement technology to analytical support for the enforcement of environmental regulations. Carbon dating and tritium analysis provided by the Geochronology Section were among the main services provided to the Alberta Research Council. Various fish and wildlife research programs were carried out for Alberta Energy and Natural Resources, while inhalation toxicology work was of primary interest to the Department of Workers' Health, Safety and Compensation. Provincial Health Units were provided services such as an extensive program of drinking water quality testing and identification of insects of public health concern.

In some cases work was carried out for other agencies or institutions, as with the successful introduction of biological agents for insect pest control in Muttart Conservatory. In several instances, such as diagnosing various crop and garden problems, services were provided direct to the public.

As well as carrying on their regular duties, staff were involved in various committees and other scientific and technical activities. For example, the Centre's Executive Director served for four months on an Energy Resources Conservation Board panel investigating a sour gas well blowout, and other staff members served on the editorial boards of scientific journals.

Where possible, Centre work used an interdisciplinary team approach with experts in diverse fields addressing a problem from different perspectives. To accommodate this interdisciplinary approach, Centre work was divided into eight Program Areas, each containing several Programs and each Program containing several Projects.



The main laboratory building including the power plant was maintained by staff of Alberta Public Works, Supply and Services.

ANALYTICAL, DIAGNOSTIC, EXTENSION AND TECHNICAL SERVICES

This Program Area provided the majority of the Centre's services offered to government departments and agencies and, in some cases, direct to the public. Work on the detection, description and understanding of environmental agents and substances ranged from operation of the province's main laboratory for drinking water testing to providing more specialized services such as identifying microorganisms. As well, services were offered in such areas as feed analysis, animal maintenance, wildlife capture, pest diagnostics, and animal pathology.

PROGRAMS

- Analytical Services (Air)
- Analytical Services (Water)
- Animal Resources
- Aquatic Biology Services
- Controlled Environment
- Geochronology Services
- Instrumentation Services
- Lake Nutrients
- Microbiological Identification Services
- Nutrition Services
- Pathology Services
- Pest Management Diagnostic and Extension Services
- Precipitation Studies
- Quality Control and Data Management
- Research Services - Chemistry
- Site Environmental Services
- Soil Analytical Services
- Technical Support Services
- Toxicology Services
- Trace Organics Analysis and Methods Development
- Wildlife Biology Services

A "weed garden" was used for plant identification, one of the many services provided by the Centre.

Air quality tests were one of a range of environmental analytical and diagnostic services provided.

Program: ANALYTICAL SERVICES (AIR)

Objectives: To provide chemical analysis for provincial government surveillance, regulatory and enforcement programs.

Progress: Routine air quality analyses were performed on gases from industrial smokestacks and on ambient air. Stack emissions were analyzed from 11 industrial plants including chemical, cement and fertilizer plants and pulp and paper mills. These samples provided data for enforcement and licensing personnel in Alberta Environment.

Samples were also collected for an ambient air testing program. Following collection from air monitoring stations throughout Alberta, air was tested for particulates, lead and other metals, benzo(a) pyrene, hydrogen sulphide and other sulphur gases, fluorides and nitrogen oxides. As well, tests were conducted on samples from a vinyl chloride monitoring project.

Over 6,600 ambient air and stack sample tests were performed, involving more than 16,000 individual tests.

Development was also continued for new test methods for substances in air.

Program: ANALYTICAL SERVICES (WATER)

Objectives: To provide water analysis services to various government departments.

Progress: A record number of samples was submitted to the Water Analysis Group for chemical testing. The majority of samples, 11,007 requiring 159,338 individual tests, were analyzed to determine the suitability of drinking water for human consumption. Most of these samples were submitted by provincial Health Units.

A further 98,049 tests were performed on 3,298 samples collected by staff of the Pollution Control Division of Alberta Environment. Water chemistry analytical support was provided to enforce the Clean Water Act, license limit discharges and for studies associated with environmental concerns.

Analytical services provided to Centre-managed programs included 19,430 chemical determinations on 719 samples. Most of those analyses were conducted in support of the Site Environmental Services Program. In addition, 200 analyses for cadmium in fish tissue were provided to the Animal Sciences Wing.

The increased number of sample submissions and the increased number of parameter requests per sample created longer throughput times for all samples and a backlog of samples to be processed by the laboratory.

Program: ANIMAL RESOURCES

Objectives: To provide laboratory animal and livestock services in support of all animal-based research programs.

Progress: Facilities were developed and animals were maintained, providing support for such animal-based research as investigations into the effects of environmental sulphur, wildlife physiology and problem wildlife. Other work included enlargement of a cattle holding facility to accommodate 12 head, and construction of pens and kennels for skunks.

Program: AQUATIC BIOLOGY SERVICES

Objectives: To provide essential services to aquatic biology research and service programs including maintenance of different species of fish and development of a treatment system providing water suitable for culturing aquatic organisms.

Progress: A team of toxicologists, chemists and ecologists from the Centre was assembled to recommend appropriate action to client departments and agencies involved in the investigation of fish kills. Advice was provided to Alberta Energy and Natural Resources in one fish kill incident.

A water treatment system was operated including a 90 per cent recycle of the 200,000 gallon per day capacity of the plant, providing water suitable for growing fish. Rainbow trout, sauger, walleye, longnose suckers and northern pike were maintained for various research projects.

The first volume of a two-book series on monitoring and impact assessment in natural waters was published and the second was in press at year end.

Program: CONTROLLED ENVIRONMENT

Objectives: To operate controlled environment growth chambers for research purposes and to provide technical assistance for the propagation of plants for research.

Progress: Ten new plant growth chambers were installed bringing the total in place to 36. The chambers were used to conduct research under simulated field conditions during the non-growing months of the year, develop preliminary information prior to field trials and follow up on field studies.

Program: GEOCHRONOLOGY SERVICES

Objectives: To provide a carbon-14 and tritium low-level analysis service and applied research capability for the solution of environmental and general earth sciences problems.

Progress: The geochronology laboratory was developed to the point where samples could be accepted for analysis of isotopes at naturally occurring levels, providing a time-frame for the rate of change of many natural processes.

Progress was recorded in sample preparation for both carbon-14 and tritium, in development of instrumentation required for the dating process, and in associated computer software development. Real sample processing was initiated for systems cross checks and a survey of tritium concentrations in groundwater samples was conducted for the Alberta Research Council. In another project, tritium analyses were conducted to determine the age and residence time of lake water.

Growth chambers were used for a variety of plant related experiments.

Program: INSTRUMENTATION SERVICES

Objectives: To undertake routine services including the repair and maintenance of Centre instrumentation and to provide instrumentation engineering services.

Progress: Repair and maintenance services were provided in response to approximately 150 requests. The services evolved from simple repairs to maintenance of complex electronic systems. Instrumentation services performed included the design, installation and start-up of various control systems and interfaces, integration of instruments into process systems, and design of sensors and measuring systems. For example, development work started on a system to monitor and record heart rate and other vital signs of captured wild animals.

Program: LAKE NUTRIENTS

Objectives: To provide analytical support for lakes and rivers eutrophication research primarily for nutrient parameters.

Progress: Water and sediment samples were analyzed for Alberta Environment's Pollution Control Division in support of research on nutrient levels in selected Alberta lakes and rivers. Most of the analytical work was performed on lake samples from Lake Wabamun and the Cold Lake area to provide information on the nutrient status of these water bodies. Investigation of the South Saskatchewan River system eutrophic status was initiated. A total of 21,000 chemical determinations was provided on approximately 500 samples for this program.

Program: MICROBIOLOGICAL IDENTIFICATION SERVICES

Objectives: To provide microbiological identification services including isolation, enumeration and identification.

Progress: This computer-assisted service was established following the development and evaluation of the rapid and comprehensive identification series, allowing genus and species level identification of microorganisms from diverse environments. The service provided to Centre user groups involved the analysis of 1,400 samples. Several bacterial reference cultures were acquired and tested to expand computer data base information. As part of culture collection, about 80 bacterial and yeast isolates were maintained through periodic transfers and quality control checks.

A report on predominant aerobic microflora of black and grizzly bears summarized results of the analysis of 60 swabs obtained from various body sites. The analysis involved an examination and identification of 328 bacteria, 82 yeast and 33 fungal isolates.

Program: NUTRITION SERVICES

Objectives: To provide nutrition analyses, diet formulation and nutritional expertise for Centre animal-based work.

Progress: About 80 per cent of work was devoted to providing nutritional analytical services and 20 per cent to consulting on Centre projects. This included 5,388 analyses of environmental samples such as moose browse and fish tissues.

Program: PATHOLOGY SERVICES

Objectives: To provide interpretive specialized pathology preparations and interpretive services to clients and the Centre.

Progress: Specialized services were provided in support of a large number of animal related Programs and Projects. Among them were: examination of fish tissues for a study of the effects of coal mine flocculants on fish; blood analyses for various wildlife trials; examination of rat fetuses; various studies on the effects of toxicants on rats; and analyses on nearly 1,000 blood samples from toxicology and pathology projects.

Program: PEST MANAGEMENT DIAGNOSTIC AND EXTENSION SERVICES

Objectives: To provide insect, plant disease, weed, and chemical damage diagnostic and extension services.

Progress: Over 2,500 insect, plant disease and weed specimens were submitted for identification in Centre laboratories. Another 835 samples were diagnosed for chemical damage to crops.

The insect laboratory identified 728 specimens, provided the only insect diagnostic and information service for the Public Health Units across Alberta, and backed up Alberta Agriculture Regional Crops Laboratories in Fairview, Olds and Brooks.

Some 1,314 plant disease specimens were processed and control recommendations offered to clients. Under Alberta Agriculture's Seed Potato Improvement Program, potato samples submitted by government field inspectors from northern Alberta were examined for bacterial ring rot. The disease was found in only one sample in the 1983 crop season. Laboratory diagnostic support was provided in aid of province-wide crop disease surveys. Staff participated in surveys of ergot and root rot of cereals and verticillium wilt of alfalfa. No disease was found in the only sample submitted for Dutch elm disease identification.

A total of 502 plants was submitted for identification and control recommendations by weed scientists. A weed garden with 70 species of weeds and an herbarium with over 3,000 mounted weed specimens were maintained to aid in weed identification. Another 835 plant, soil and water samples were processed in cases of suspected chemical damage to plants. Biological tests, visual examinations and instrumented analyses were used to identify the problem chemicals.

Staff continued an active round of agricultural extension and advisory activities which included responding to pest control inquiries, presenting talks to groups such as farmers, students and homeowners, and producing informative publications on pest management. Extension activity also included holding the first Crops Field Day at the Centre where farmers were invited to view agricultural research plots.

Backup diagnostic services were provided to Alberta Agriculture Regional Crops Laboratories where necessary.

Plants were submitted for disease diagnosis by farmers, gardeners, extension workers and others.

Over a quarter million individual tests were performed in chemistry laboratories.

Program: PRECIPITATION STUDIES

Objectives: To provide analytical services for acid rain studies and to help solve environmental problems related to acid rain.

Progress: The Centre participated with Alberta Environment's Research Management Division in an acid rain study in the oil sands area of the province. As well, precipitation samples were routinely analyzed from six monitoring stations. During the year, approximately 500 samples were analyzed with 6,000 individual tests. Another 40 samples were analyzed with 500 tests as part of four quality control studies under the federal government Long Range Transport of Atmospheric Pollutants (LRTAP) study.

Program: QUALITY CONTROL AND DATA MANAGEMENT

Objectives: To provide high-quality analytical results through an appropriate quality assurance program using the mechanism of quality control.

Progress: Collaborative studies were conducted as follows:

- an on-going Prairie Provinces Water Board study for water quality parameters, coordinated by the National Water Resource Institute and the Canada Centre for Inland Waters;
- an interlaboratory study of mercury in fish, coordinated by the Freshwater Institute in Winnipeg;
- vinyl chloride monitoring in ambient air and the determination of oxides of nitrogen in source emissions, coordinated by the Centre.

As well, about 10 per cent of total analyses conducted by the Centre were subjected to quality control tests.

Program: RESEARCH SERVICES - CHEMISTRY

Objectives: To provide technical expertise on specific projects.

Progress: Assistance was provided to the Animal Sciences Wing in the installation and calibration of equipment for sulphur gas analysis. Work was completed on the analysis of selected organic compounds in pulp and paper effluents and fish tissue in cooperation with the Animal Sciences Wing. Development work was also completed on the analysis of volatile priority pollutants in water.

Program: SITE ENVIRONMENTAL SERVICES

Objectives: To minimize any negative environmental impact of the Centre.

Progress: An interim wastewater treatment plant was operated to handle and treat wastes generated by the Centre. Wastes not suitable for treatment and discharge were stored in a lagoon.

A reverse osmosis water treatment system was operated, delivering up to 11,500 litres of reagent quality water daily to Centre laboratories.

Program: SOIL ANALYTICAL SERVICES

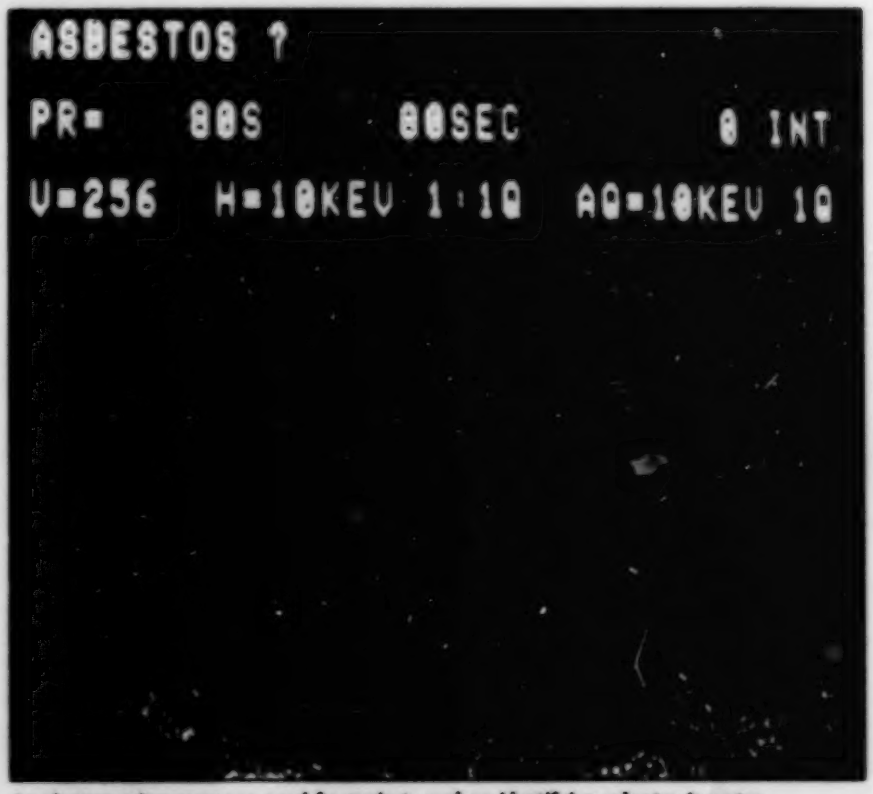
Objectives: To provide a soils analytical and consulting service for government agencies working in the environmental and reclamation aspects of soil science.

Progress: A basic line of equipment was acquired for routine chemical and physical tests on soils. Soil tests were carried out for selected projects in weed science, vegetation ecology, and engineering. Specialized analytical services were provided in the measurement and interpretation of the effects of brine spills on forest and agricultural soil. Staff also designed several survey and experimental programs for measuring the effects of pollutants around industrial sites in the province, and started a project to map soils of the Centre by computer.

Program: TECHNICAL SUPPORT SERVICES

Objectives: To provide electron microscope analytical services.

Progress: Electron microscope analytical services were first offered in July, 1983. Over 400 electron microscope investigations were carried out and 2,000 micrographs were prepared. Public Health Units submitted 60 requests for the examination of asbestos in public water supplies, while other investigations were carried out in support of Centre projects such as the determination of chromium uptake by bacteria.



An electron microscope was used for projects such as identifying asbestos in water.

Program: TOXICOLOGY SERVICES

Objectives: To provide toxicological support services for Centre activities and to provide access to a multi-media toxicological information base.

Progress: Toxicology information services were provided to various groups and individuals through public meetings and a toxicological information base. Discussions were held with farmers, industry officials and others in the Peace River region about the possible effects of industrial activity on soil acidity, water quality and animal health. Advice was provided at public meetings and to Environment Department officials on subjects such as hazardous waste treatment, risk assessment and toxicity of specific chemicals.

The toxicology information base included such sources as books, periodicals, microfiche, computer data bases, reprint collections and other libraries.

Program: TRACE ORGANICS ANALYSIS AND METHODS DEVELOPMENT

Objectives: To provide trace organic compounds analytical services, excluding pesticides which are included in a separate Program.

Progress: A total of 709 samples was analyzed for a range of organic constituents. Of these, ninety-two per cent were conducted for Alberta Environment's Pollution Control Division, four per cent were for Public Health Units, and four per cent were for Centre Projects.

The majority of analytical requests were for priority pollutant type analyses which constituted sixty-six per cent of the samples. Polychlorinated biphenyl (PCB) and hydrocarbon analyses made up the remaining thirty-four per cent of the requests.

Program: WILDLIFE BIOLOGY SERVICES

Objectives: To provide periodic short-term support in wildlife biology to the Centre and client agencies.

Progress: Periodic services were provided to client departments and to Centre programs as required. This included providing advice and assistance in areas such as wildlife capture. A special net gun is owned by the Centre and has been loaned to other research agencies in Canada and abroad.

Planning for new wildlife research was included in this Program. Among potential new projects were studies on moose populations and on furbearing animals.

PEST MANAGEMENT RESEARCH AND DEVELOPMENT

Research into ways of reducing pest damage through the use of integrated, environmentally acceptable control methods made up the core of this Program Area. Work included an examination of chemical, cultural and biological control methods as well as chemical studies to detect and analyze pesticides in the environment.

PROGRAMS

- Pesticide Analysis and Methods Development
- Plant Pathology Research and Development
- Insect Pest Management Research and Development
- Weed Management Research and Development

Several thousand individual test plots were planted for agricultural experiments.

Program: PESTICIDE ANALYSIS AND METHODS DEVELOPMENT

Objectives: To analyze pesticide residues in water, soil, sediment, and other matrices, and to develop analytical methods for this work.

Progress: During the year, a total of 681 samples was analyzed for low level pesticide residues in water, sediment, soil and other substances. Sixty-two per cent of the samples were analyzed for Alberta Environment's Pollution Control Division, providing input to the Department's program of maintaining clean water standards and aiding in the formulation of recommendations for pesticide use and application rates.

Over 32 per cent of the samples were analyzed for the Plant Sciences Wing at the Centre. Most of these were in support of the weed diagnostic and extension services Project, including the chemical damage investigation service. Five per cent of the samples were analyzed for Public Health Units, and the other two per cent for various other clients.

Work continued in the development of methods of chemical analysis. The following methods were completed:

- analysis of Trifluralin, Triallate and Diallate in soil and vegetation;
- analysis of Dicamba, 2,4-D, Picloram, 2,4,5-T, MCPA and Hoe Grass in water, sediment and soil;
- analysis of 30 individual organochlorine pesticides in water;
- analysis of Bromacil and Bromoxynil in soil and vegetation;
- analysis of Monuron, Diuron, Linuron and Tebuthiuron in soil and vegetation.

Work in developing chemical methods of analysis resulted in publication of three articles in scientific journals. Development work on the analysis of herbicides in soil and vegetation continued.

Plant disease organisms such as the one causing septoria of wheat were investigated.

Program: PLANT PATHOLOGY RESEARCH AND DEVELOPMENT

Objectives: To develop information on the protection of field crops, ornamentals and turf in Alberta through applied research on plant disease prevention and control.

Progress: Experiments on major plant diseases were conducted at the Centre. Several studies were carried out on alfalfa decline, a disorder of unknown origin which is a major problem for forage producers. Studies on the role of soil sulphur deficiency in alfalfa decline were completed on farms near Smoky Lake. In addition, field plots were planted at the Centre to test alfalfa varieties for resistance to three fungi which may be associated with alfalfa decline.

To provide information on the registration of new disease control chemicals, and to confirm the effectiveness of registered chemicals, seed treatments for barley root rot and smut and wheat root rot were tested. Chemicals were also tested for control of white mold and seedling blight of canola, and laboratory and field studies were conducted on the effect of herbicides on cereal disease development.

Plant disease surveys were conducted to find new diseases and to determine the level of infestation of established ones. The virulent strain of blackleg was found for the first time in Alberta during a survey of canola crops near Vermilion. In another survey, black stem, downy mildew and common leaf spot were found to be the

most common alfalfa diseases. Surveys of cereal crops in northeast Alberta showed that foliage diseases of barley and wheat are increasing.

Two disease organisms were tested for their ability to control root-knot nematodes in greenhouses. Prevention and control of apple fireblight were studied, using a bacterium which may provide protection against the organism causing the disease. Studies on shoot blight and canker diseases of poplar were started.

Program: INSECT PEST MANAGEMENT RESEARCH AND DEVELOPMENT

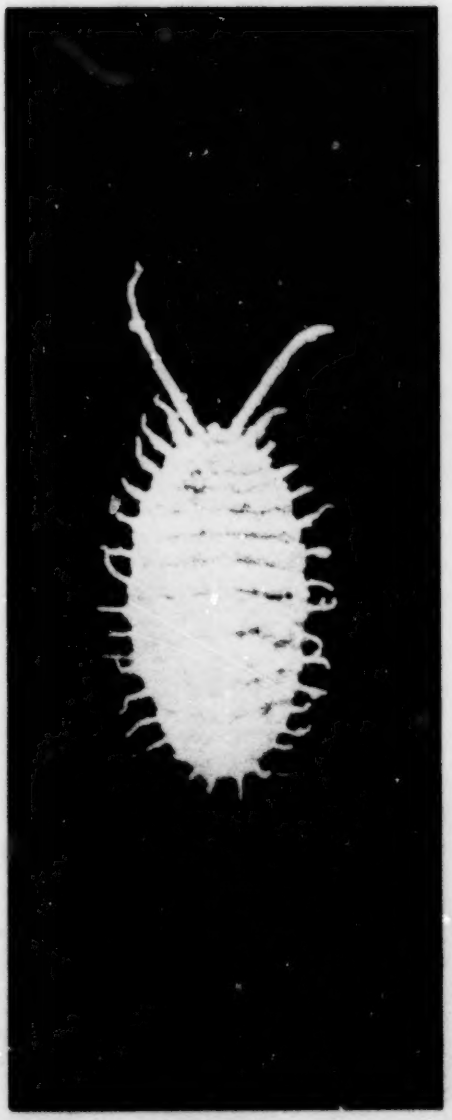
Objectives: To develop information on the protection of ornamental and horticultural crops, field crops, livestock and poultry through insect pest management.

Progress: Several insects and a mange mite were studied to establish their status as pests. For example, a three-year survey ending in 1983 showed that root maggots infest canola in cooler, wetter regions of Alberta such as the northwest and the Peace River region. Research on the effects of root maggots on canola yield started in 1983, and trials were also conducted on the effects of flea beetle feeding on canola.

Further research was aimed at detecting, assessing and forecasting the sizes of pest populations. A pilot project was started in the Bonnyville area to see if weather measurements can help determine the likelihood of grasshopper infestations. Studies from 1981 to 1983 indicated that Bertha armyworm traps baited with a sex attractant to lure moths are useful south of Calgary in predicting outbreaks of the insect. The trapping technique also proved useful in predicting clover cutworm outbreaks in the northern Peace River region, but its accuracy for Bertha armyworms declines north of Calgary. A sampling method to establish whether damaging numbers of Bertha armyworms are present in crops was improved. Surveys for elm bark beetles, the carriers of Dutch elm disease, again established that the province remains one of the few areas in North America which is free of the disease.

Research emphasis was on integrated control techniques, using biological as well as chemical methods. Predators and parasites of insect pests in the Muttart Conservatory in Edmonton were introduced and monitored as required, continuing work which has successfully reduced the need for chemical control. Work in commercial greenhouse pest control included testing of promising insecticides for chrysanthemum leaf miner, and research on biological control of cucumber whiteflies. Control of root maggots in home gardens was investigated, including field trials on chemical control on rutabagas. As well, commercial potato fields near Edmonton were monitored for the presence of tuber flea beetles, a pest which is so far limited to fields near urban areas.

Studies on livestock insect control showed excellent control of cattle horn flies from experimental insecticide products such as ear tags and backrubbers. An experimental poultry feed-through product was tested for control of house flies in layer barns, and preliminary work started on the use of parasitic wasps to control flies in confinement barns.



Biological control of greenhouse insect pests such as this obscure mealybug was studied.

An automated weather monitor was used in conjunction with crop protection research.

Program: WEED MANAGEMENT RESEARCH AND DEVELOPMENT

Objectives: To determine through applied research the magnitude of weed problems and economic losses due to weeds in Alberta, to generate and develop information on weed management and to provide this information to the public.

Progress: Research was carried out in three general areas - weed biology and ecology, biological control of weeds, and herbicides and chemical weed control. In weed biology and ecology, 17 field trials were set up to study the competitiveness of various weeds in barley, wheat and canola. A field experiment to determine the long-term economic impact of threshold levels of wild oats was also established. Growth chamber experiments were set up to study the relative competitiveness of various crops and weeds under different moisture and nutrient conditions.

Related biology and ecology work included field and growth chamber studies of seed germination and weed growth characteristics, development of ways of breaking weed seed dormancy and continuation of a multi-year study on survival of weed seeds after burial in soil. As well, leafy spurge was investigated to determine the number of types present in Alberta on the basis of chemicals present in the plants. This work is aimed at preventing the development of a serious problem from the weed that has just started to infest Alberta.

Herbicide and chemical weed control work involved 54 field experiments in five areas: influence of environmental variables on herbicide performance; tolerance of barley and wheat varieties to herbicides; weed control in canola and cereals; rotational crop tolerance to herbicide residues in soil; and role of herbicide application in disease incidence and development in cereals. Growth chamber experiments were conducted to develop a bioassay technique to determine Glean residues in soil and on efficacy of several herbicides under different soil moisture regimes. Research results were reported to weed research, advisory, and extension agencies.

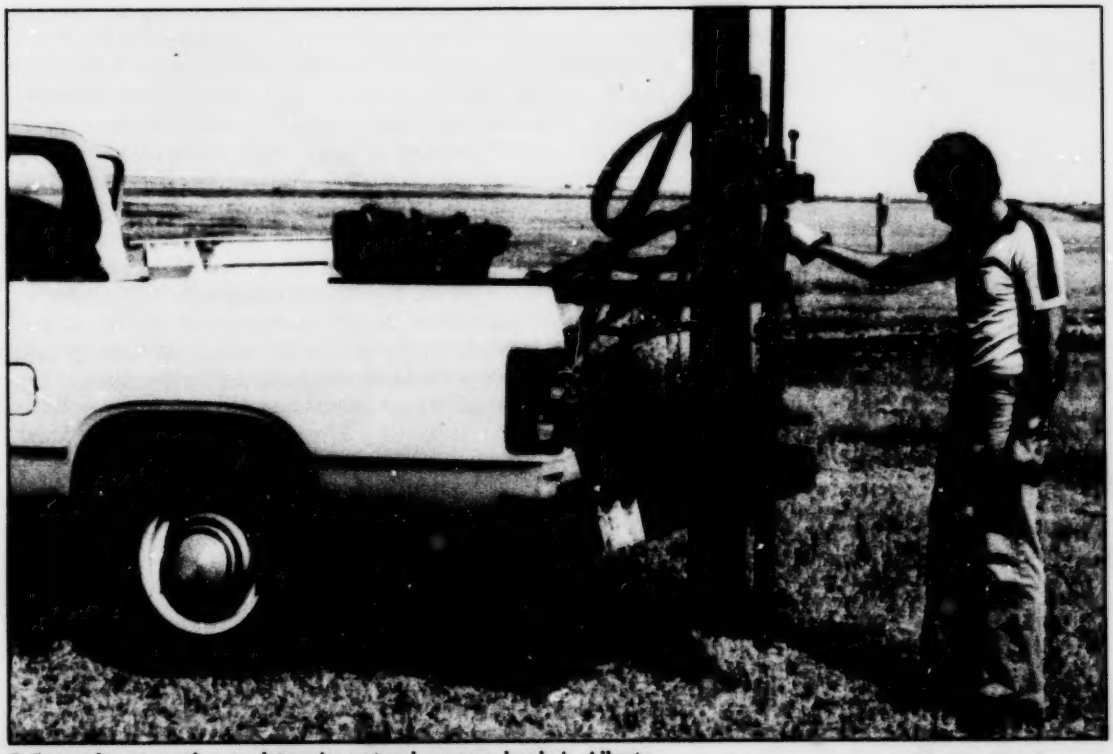
In biological control of weeds, a midge from Europe was released at Ribstone and Vegreville for control of perennial sowthistle, and two species of European beetles which attack leafy spurge were released at Cardston. Studies sponsored by the Centre on another potential biocontrol agent for leafy spurge were continued in Europe by the Commonwealth Institute of Biological Control.

WATER/WASTEWATER RESEARCH AND DEVELOPMENT

Work in this Program Area concentrated on ways of supplying water for drinking, recreational, agricultural and industrial uses while minimizing environmental impacts. Among specific objectives were gaining an understanding of the effects of industrial effluent on water quality and development of a demonstration plant to evaluate water treatment technology in the province.

PROGRAMS

- Aquatic Toxicology
- Chemical Residues in Alberta Waters
- Environmental Chemistry of Wastewater
- Water Quality Improvement



Soil samples were taken to determine natural mercury levels in Alberta.

Program: AQUATIC TOXICOLOGY

Objectives: To determine the toxicity of industrial effluents to fish and to identify toxic components of wastewater.

Progress: The toxicity of industrial wastewaters in Alberta was measured using rainbow trout as the test organism. A total of 25 such tests was conducted on effluents from 10 categories of industry ranging from building products to thermal power. From the 25 tests, the effluent was found acutely toxic in only three cases.

Studies were carried out on the toxicity to fish of pulp mill effluents and coal mine flocculants. Based on laboratory and field investigations, it was concluded that existing regulations for pulp mill effluents are adequate to protect fish in the Wapiti River. Similarly, following studies of 11 different coal mine flocculants, it was concluded that use of the compounds at recommended rates does not present a major threat to fish.

Program: CHEMICAL RESIDUES IN ALBERTA WATERS

Objectives: To determine chemical residue levels in fish from major lakes and rivers in Alberta.

Progress: Work was completed on a survey of concentrations of polychlorinated biphenyls (PCBs), mercury and 43 pesticides, in fish collected from major Alberta waterways. Findings indicated that the levels of PCB and pesticide residues do not constitute an immediate threat to fisheries resources in Alberta.

In work concentrating on mercury, residue levels in fish from six major southern Alberta rivers were determined. Mercury levels were elevated in some cases, a finding consistent with earlier studies in the North Saskatchewan River. This led to the design of a study using sediment cores to determine the source of mercury in southern Alberta rivers. Related studies were undertaken on the method by which fish take up mercury from their environment. This included a laboratory investigation of the effects of other metals and varying amounts of dissolved organic matter on mercury uptake.

Analytical methods were developed to measure the concentrations of specific oil and grease compounds in Athabasca River fish. This was part of a study to determine if these fish naturally contain relatively high levels of some oil and grease compounds because the river flows through oil sands deposits.

Program: ENVIRONMENTAL CHEMISTRY OF WASTEWATER

Objectives: To identify the toxic components of industrial effluents and recommend treatment methods.

Progress: Work in this Program was concluded with successful trials to determine which portions of several industrial effluents are toxic. A technique to separate the wastewater into its components, coupled with biological toxicity tests, was used to evaluate the toxicity of the various portions of the effluent.

Program: WATER QUALITY IMPROVEMENT

Objectives: To evaluate, improve and demonstrate water and wastewater treatment processes and hardware.

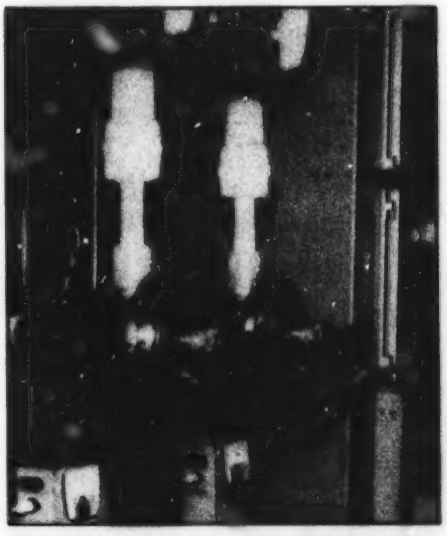
Progress: Work progressed in two general areas: studies on the effects of pulping effluent on the quality of potable water; and development of a mobile water treatment plant for the evaluation of water treatment technology in Alberta.

Work on the effects of pulp mill effluent proceeded on several fronts including program planning, organization of a workshop on the subject, information gathering and development of test methods.

The pulp mill effluent workshop, held in September, was a continent-wide gathering of experts in the field. Participants concluded that the main areas requiring research are effluent colour removal and taste and odour control, and water treatment processes for surface water containing pulping effluents. Concern was expressed about reports of effects on livestock of water containing effluents.

An extensive collection of articles on the subject was gathered through a literature search, and initial work was carried out on taste and odour test methods while various colour removal processes were examined in the laboratory. As well, a study on modelling the fate of certain contaminants in northern rivers was contracted out.

Specifications for the mobile water treatment facility were approved and plans were made to purchase the unit. It was decided that treatment of waters which receive pulp mill effluent will be one of the early experimental uses of the laboratory. It will also be used to evaluate and develop treatment technologies suitable for difficult-to-treat sources.



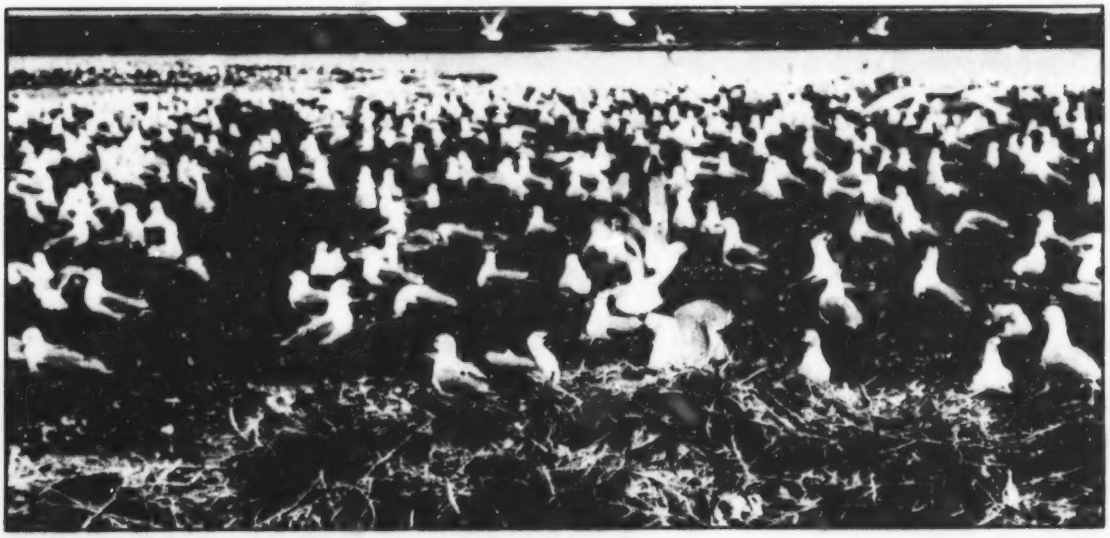
Water from fish tanks was recycled through this treatment system.

ENVIRONMENTAL TOXICOLOGY

Environmental toxicology studies examined the potentially harmful consequences of chemicals or agents of natural or human origin which are introduced into air, land or water systems.

PROGRAMS

- Chemical Safety Evaluation
- Ecological Toxicology
- Effects of Environmental Sulphur
- Genetic Toxicology
- Inhalation Toxicology
- Toxicology of Biocides
- Toxicology of Petrochemicals and Fossil Fuels



The effects of pesticides on terrestrial ecosystems were studied.

Program: CHEMICAL SAFETY EVALUATION

Objectives: To evaluate the effects of toxic or potentially toxic substances of environmental concern as they may affect man or other animals.

Progress: The Centre responded to a number of requests from various sources for information on the hazards and risks associated with particular chemicals or mixtures.

Program: ECOLOGICAL TOXICOLOGY

Objectives: To evaluate the biological and ecological impact of environmental contaminants on terrestrial wildlife.

Progress: The initial focus of the program was directed toward identifying potentially toxic chemicals in Alberta wildlife. Double-crested cormorants were identified as a species suitable for assessing the accumulation of toxic chemicals in aquatic systems in Alberta. Plans were drawn up to determine the level of residues in eggs and juvenile birds in six different colonies. Egg residue levels were selected as a way of gathering data on potential impact on bird reproduction, while residues in juvenile birds were chosen as a measure of the significance of chemicals accumulated locally as opposed to those from the birds' wintering grounds.

Program: EFFECTS OF ENVIRONMENTAL SULPHUR

Objectives: To study the effects of sulphur-containing emissions with emphasis on direct and indirect effects on livestock.

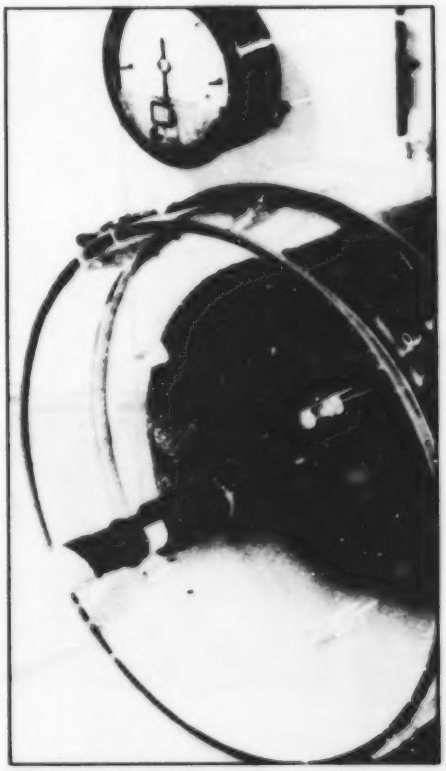
Progress: Studies continued on the relationship between certain livestock diseases and sulphur-containing emissions from natural gas processing plants and other industrial sources. The possible antagonism of sulphur and selenium in animal diets was investigated in three trials. In one, the activity of five blood enzymes in cattle fed large amounts of sulphur was examined. A preliminary selenium deficiency study in rats was conducted and the third trial, investigating the antagonism of sulphur and selenium in dietary excess and deficiency for male and female rats, was started.

Blood enzyme levels in cattle which had been exposed to a natural gas well blowout were monitored for one year after the start of the blowout. The enzyme tests were used as a means of detecting trace element deficiencies and other conditions which might be affected by sulphur.

Program: GENETIC TOXICOLOGY

Objectives: To study toxic or potentially toxic chemicals and their ability to cause mutations, cancer or birth defects.

Progress: In the laboratory, a study was completed on the effects on rats of a substance known to cause birth defects. This preliminary work was in preparation for studies on chemicals whose effects are not known.



Gas exposure chambers were acquired for inhalation toxicology studies.

Program: INHALATION TOXICOLOGY

Objectives: To undertake inhalation studies to determine toxic effects of gases, vapours, particulates and aerosols on animals and, by extrapolation, man.

Progress: Work progressed on two main fronts. First, activity was aimed at developing the physical facilities, including an air supply and exhaust system, exposure chambers, and monitoring and safety devices required for inhalation toxicology studies. Second, work progressed on the study of the effects of prolonged exposures at levels found in occupational settings.

The major event in facility development was the start on construction of an inhalation toxicology laboratory. The facility, annexed to the main laboratory building, was designed to contain and manage gases and airborne materials, allowing the study of occupational hazards, the effects of inhaling noxious substances and the effects of long-term, low-level exposures to toxic or potentially toxic airborne materials. The initial gas under consideration was hydrogen sulphide.

Space was developed for initial hydrogen sulphide experiments prior to completion of the main inhalation laboratory. Four custom-designed, 60-litre chambers for exposing test animals to gases were put in place.

Preliminary work was completed to develop and assess the toxic effects of inhaled compounds.

Animal cells were examined in studies on the toxic effects of chemicals.

Program: TOXICOLOGY OF BIOCIDES

Objectives: To study the effects of pesticides with emphasis on their adverse effects on non-target animal species.

Progress: Work continued on a project to identify whether some cattle breeds are more sensitive than others to certain pesticides and whether this sensitivity is affected by age and sex of the animal. This involved laboratory and field work to determine the natural level of a blood enzyme in cattle of different age, breed and sex.

Work was also carried out to identify areas of pesticide research which are required for the province.

Program: TOXICOLOGY OF PETROCHEMICALS AND FOSSIL FUELS

Objectives: To study the effects of crude and refined petroleum products, drilling fluids, additives, flyash and emissions on animals.

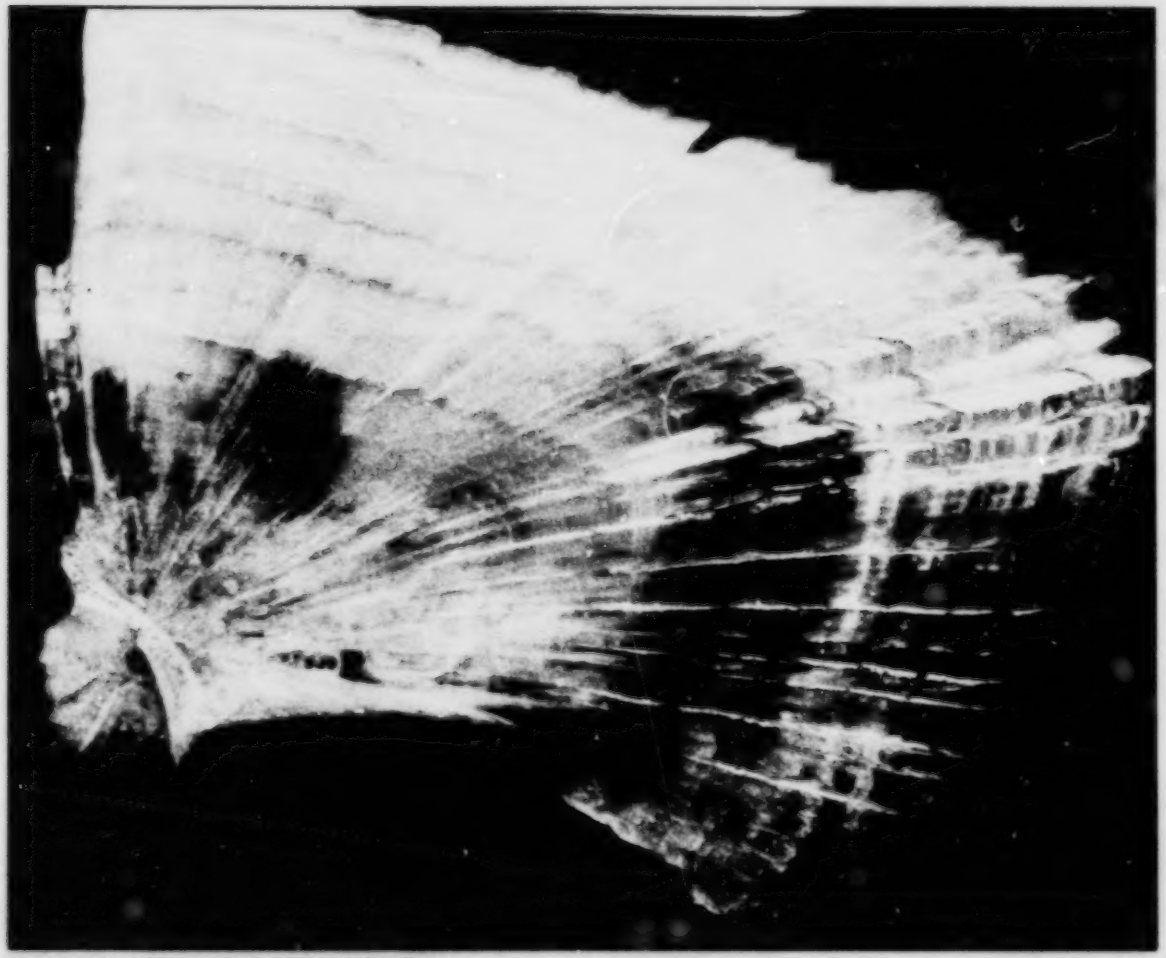
Progress: There was some consultation in response to concern about the potential of waste drilling fluids contaminating a stock water supply. However, it was decided that future activities need to be defined relative to potential problems associated with coal mining, oil sands technology and fossil fuel extraction processes. Informal discussions with client departments were held to re-define the direction of the Program.

LIVING NATURAL RESOURCES

Physical, chemical and biological changes and their effects on a range of living natural resources such as grasslands, forests, aquatic species, birds and wild mammals were the focus of work in this Program Area.

PROGRAMS

- **Aquatic Habitat Studies**
- **Environmental Physiology**
- **Forestry Development and Wildlife Resources**
- **Problem Wildlife**



Bones were used to determine the age of fish.

Program: AQUATIC HABITAT STUDIES

Objectives: To determine population statistics in fish in response to perturbations.

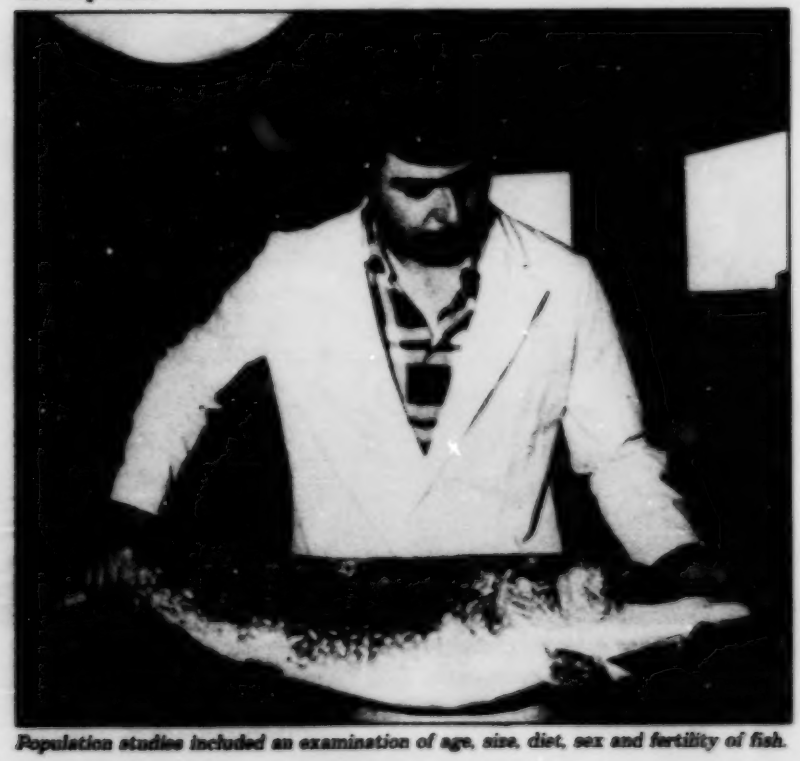
Progress: Work started on a study of the abundance, growth, reproduction and death rates of walleye and pike in three lakes in northeastern Alberta where heavy oil developments are expected. The study, involving capture and examination of fish from the lakes was intended to provide fish population data before the industrial development. Information on age, size, diet, sex, and fertility of the captured fish was recorded.

Program: ENVIRONMENTAL PHYSIOLOGY

Objectives: To obtain information on animal-environment interactions to enhance the ability to manage animal and environmental resources.

Progress: A project to evaluate the distribution and availability of moose browse in the Swan Hills relative to animal and range productivity and animal distribution was in the wind-down phase. The browse study also compared nutrient availability from browse in different forest cover types in the Swan Hills. With field components of the study complete, laboratory analysis of browse samples and analysis of data were major activities.

New work included design of a research system for the study of large animals involving considerable on-site electronics and computer systems. Intensive work with captive elk was started in preparation for studies on animal-environment interactions including environment and animal management and resource use and development.



Population studies included an examination of age, size, diet, sex and fertility of fish.

Program: FORESTRY DEVELOPMENT AND WILDLIFE RESOURCES

Objectives: To obtain data to assist with long-range planning and development of forested areas relative to wildlife.

Progress: Studies of grizzly and black bear populations in an area of northern forest scheduled for logging neared completion. A final season of trapping and fitting bears with radio collars was completed, bringing to 38 the number of animals equipped with the collars over the three years of the study. A total of 121 bear captures representing 38 individual grizzly and 32 black bears was recorded during that period. Extensive data were collected on animal weight, blood, feces, and other characteristics during the trapping.

During the project, trap transmitters were developed to aid in aerial monitoring of traplines, a remote motion triggered video camera was used to film bears during and after capture and monitors were built and used to measure heart and respiration rates and other responses of captured bears.

In a second project, studies were carried out to assess the feasibility of using satellites to classify and map wildlife habitats in the Berland Timber Management Area. Techniques were developed to evaluate the habitats for grizzly and black bears, and to monitor land use patterns in the forest.

Northern forest habitats were studied from the air and the ground.

Program: PROBLEM WILDLIFE

Objectives: To conduct research on vertebrate pests of agricultural concern.

Progress: Trials were carried out to evaluate poisons which are potential alternatives to strychnine, a relatively non-selective chemical used to control coyotes and skunks. This included a study of coyote baiting techniques with an examination of bait uptake by non-target animals.

Field tests were carried out to evaluate poisons for skunk control. As well, tallow baits and poisoned eggs for skunk control were tested, demonstrating the need for an odour lure to attract the animals.

Studies continued on the use of toxic collars on orphan lambs as a means of selective coyote control. This followed work which had shown that predators tend to attack small, orphan lambs rather than larger sheep with mothers. The study showed that although coyotes attacked the lambs with collars, the collars were often not punctured, pointing out the need for a new design.

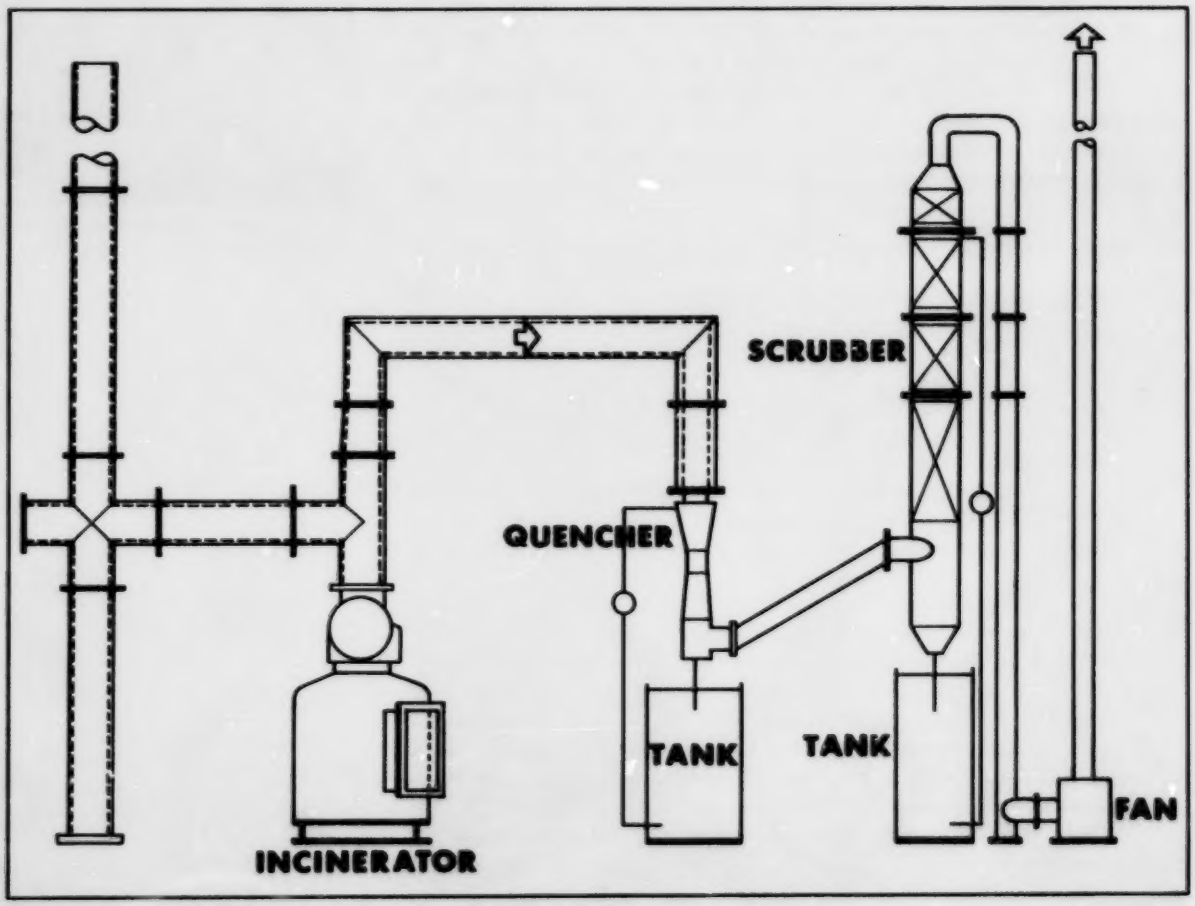
Work on pocket gopher control neared completion. Reports were prepared on movement of the pests onto new legume fields and the effect of grazing intensity on pocket gopher populations.

WASTE MANAGEMENT RESEARCH AND DEVELOPMENT

Work proceeded from the perspective that agricultural, industrial and municipal wastes are potential resources which may be economically exploited thereby reducing costs and the negative environmental impact of disposal. Within the general objective of evaluating and testing waste handling and disposal techniques, the focus was on physical, chemical and biological processes which may be applied to waste management.

PROGRAMS

- **Microbiological Aspects of Waste Management**
- **Physical/Chemical Processes in Waste Management**



Incineration and scrubbing technology research was carried out.

Program: MICROBIOLOGICAL PROCESSES IN WASTE MANAGEMENT

Objectives: To provide information on municipal, industrial and agricultural waste management practices and alternatives using microbiological processes.

Progress: The use of microbiological processes to generate information on waste management practices and alternatives was examined in four major projects. In one, the microbiological breakdown of landfill material was studied to provide information on such potential problems as leaching, gas migration and surface sinking. Instrumented test sites were established at landfills in Leduc and Pincher Creek and information was collected on daily temperature and gas production.

Another project, involving nine surveys and four cattle feedlots, gathered information on the environmental impact of feedlot wastes on water. The surveys involved collection of 175 samples with about 1,600 microbiological tests as well as 1,600 chemical tests performed on 40 samples.

Studies continued on the use of bacteria to test the toxicity of materials such as industrial effluents. Following laboratory studies, the bacterial test systems were changed to make them more accurate, sensitive and useful. Using these modified procedures, tests were performed on various metals and their mixtures, industrial effluents and experimental leachates.

Work continued on the potential use of bacteria to eliminate heavy metals from sewage sludges. The mechanism of hexavalent chromium uptake by a selected bacterium was studied using electron microscopy/x-ray analysis.

Research into ways of making better use of wood, straw and similar wastes concentrated on the microbial conversion of straw and Aspen poplar into products useful as animal feed. Preliminary screening was completed on five fungal isolates for their ability to grow on chipped Aspen wood without added nutrients.

Program: PHYSICAL/CHEMICAL PROCESSES IN WASTE MANAGEMENT

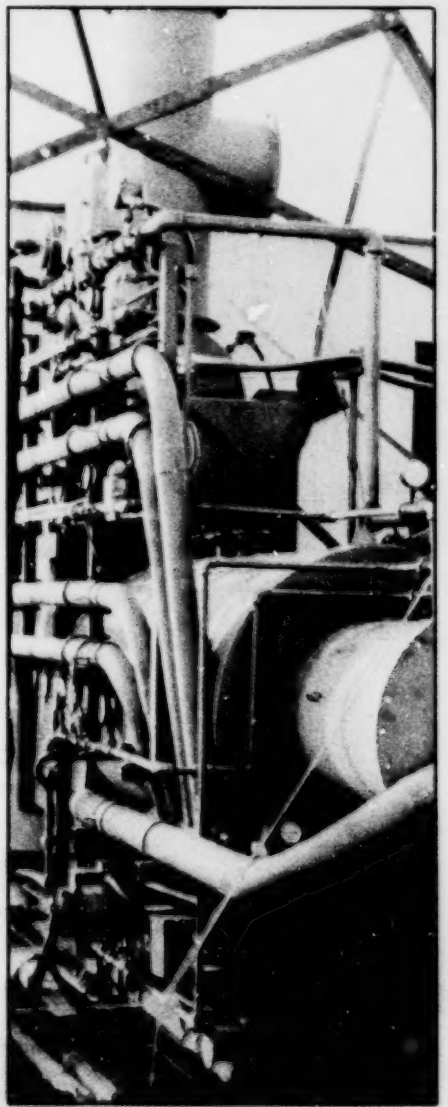
Objectives: To develop technically and economically viable processes for dealing with pollution problems.

Progress: Progress was recorded in three areas: development and testing of emission control technology, waste incineration, and waste fixation.

Staff successfully carried out a field test of a system for removing sulphur dioxide from emissions at a sour natural gas processing plant. The process used magnesium oxide to remove the sulphur dioxide while producing a potentially saleable byproduct. The work, which received the active support of industry, resulted in tail gas sulphur dioxide removal efficiencies of 95 to 99 per cent under a wide range of operating conditions.

A pilot scale incinerator for solid and liquid wastes was acquired for studies on conditions required for the incineration of Alberta wastes. Modifications to the unit were made including addition of a ram waste feeder, monitoring instruments, gas samplers, analyzers and treatment equipment. Plans were drawn up for construction of a building to house the incineration facilities.

Progress was recorded in efforts to assess the use of solidification processes for managing wastes under Alberta conditions. The main activity was a workshop with representatives of government agencies, research institutions, vendors and potential users from Canada and the U.S. in attendance. Agreement to co-operate on waste research was reached with the U.S. Environmental Protection Agency and Environment Canada's Canada Centre for Inland Waters. The Environmental Centre's part in the co-operative study includes an assessment of fixation processes under Alberta conditions, development of tests for the processes and prediction of contaminant release from solidified wastes.



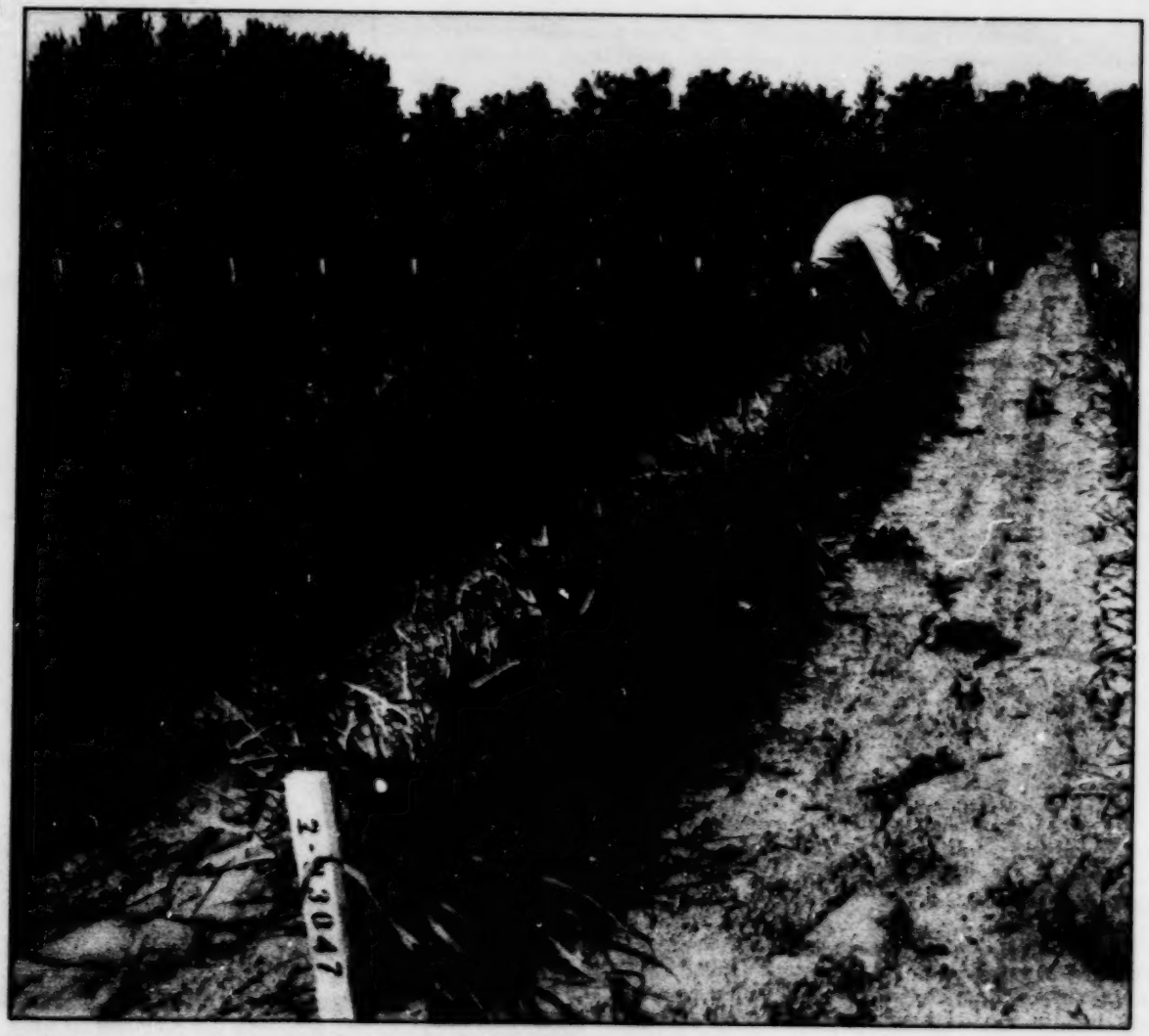
An incinerator was purchased for waste management studies.

LAND RESOURCES MANAGEMENT RESEARCH AND DEVELOPMENT

This Program Area had the objective of examining the long-term effects of major uses on Alberta's land resources. Emphasis was on reclaiming disturbed sites and providing technical solutions to land-use problems.

PROGRAMS

- **Environmental Impact on Soil Ecology**
- **Native Species for Reclamation**
- **Soil Reclamation Research**



Work commenced on selection of native plants useful in reclaiming disturbed soils.

Program: ENVIRONMENTAL IMPACT ON SOIL ECOLOGY

Objectives: To conduct soils research to identify the ecological consequences of environmental disturbances.

Progress: Soil scientists began looking for an early warning system to indicate if soils are being affected by factors such as trace metal contamination or exposure to other pollutants. Initially the nitrogen-fixing capacity of legumes will be studied as an indicator of adverse effects on the plant-soil system.

A related study began looking for ways of predicting soil changes due to long-term, low-level exposure to sulphur. Laboratory techniques were used to accelerate changes in forested soils due to the addition of low levels of sulphur dioxide, thereby indicating the nature and rate of change in soils caused by this chemical.

Program: NATIVE SPECIES FOR RECLAMATION

Objectives: To develop native plant species for erosion control, wildlife range improvement and land reclamation, and to select lines that can be propagated by agronomic means of seed production.

Progress: Work started toward developing registered varieties of plants useful in reclaiming and improving lands in sensitive areas such as the tar sands, the short-grass prairie and high-altitude regions. The goal was to develop registered seed varieties of species suitable for reclaiming stressed environments.

Specific projects included the takeover of University of Alberta research to develop commercial varieties of native species for reclaiming disturbed sites in alpine regions. Another project was aimed at developing ways of propagating native shrubs to reclaim oil sands tailings areas. Considerable progress has been made on some shrubs while others need more work. The work was streamlined to concentrate on four species.

Research was also planned on 24 species of native plants which have potential for restoring disturbed native short grass prairie. This work arose from the transfer to the Centre of 24 species from the Devonian Botanical Gardens.

Program: SOIL RECLAMATION RESEARCH

Objectives: To carry out applied research in soil chemistry, physics and biology to identify constraints on land reclamation and to provide efficient means of restoring land productivity and stability.

Progress: Preliminary work began in three areas of soil reclamation research: prediction of mine spoil behaviour as a root zone material based on core sample tests before mining; effects of soil and mine spoil compaction on plant growth; and determination of how soil type influences handling procedures in pipeline right-of-way reclamation.

Four experiments were put in place designed to: (1) identify physical and chemical properties controlling the suitability of soil and geologic materials for plant growth; (2) characterize the relationship of machinery operation to soil compaction as influenced by water content and soil type; (3) measure the effect of soil compaction on plant root extension; and (4) test a device to measure soil strength as a predictor of mechanical impedance to water movement and root growth.

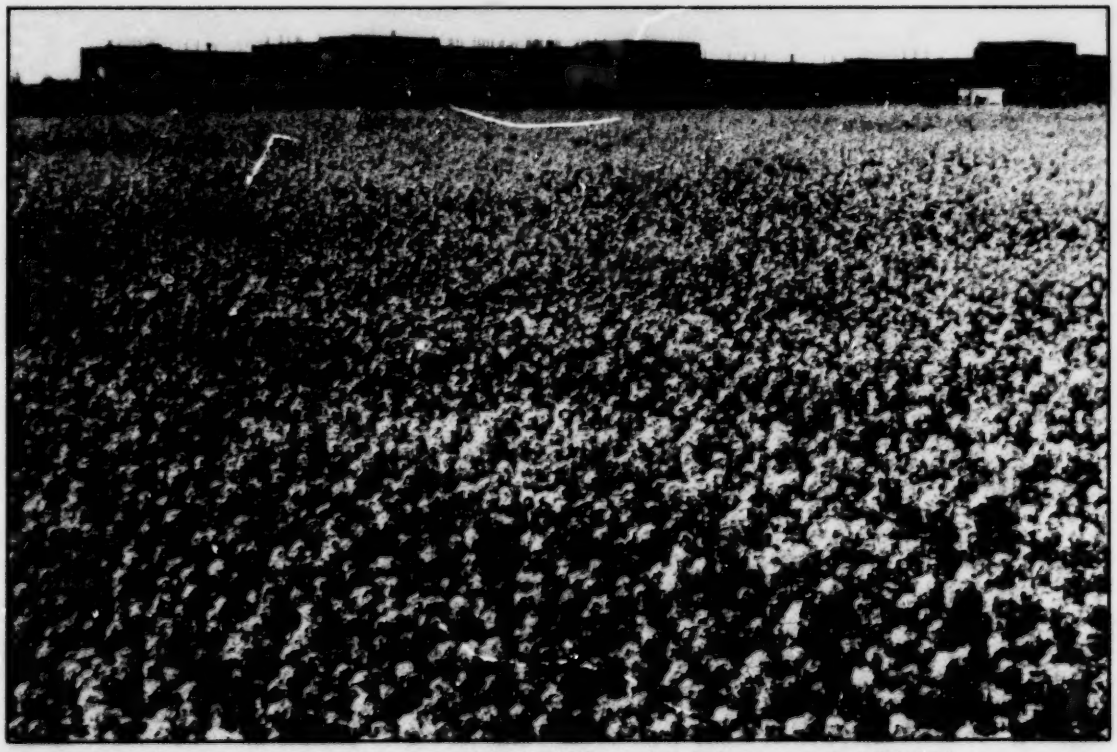
New research on Alberta's land resources was started.

ADMINISTRATIVE SUPPORT

Administrative Support activities provided the services needed to achieve the Centre's research, technical development and client services objectives. They included the central support services provided to all Wings by the Common Services Wing plus administration of the scientific and technical Wings and management of the site and facilities.

PROGRAMS

- **Administrative Services - Animal Sciences Wing**
- **Administrative Services - Chemistry Wing**
- **Administrative Services - Common Services Wing**
- **Administrative Services - Environmental Technology Wing**
- **Administrative Services - Plant Sciences Wing**
- **Capital Facilities Development**
- **Site Support Services**
- **Technical Services**



The approximately 750-acre site was maintained and developed for work including crop and wildlife trials.

Program: ADMINISTRATIVE SERVICES
- ANIMAL SCIENCES WING

Objectives: To provide administrative and research support for Wing programs and projects, and experimental design and statistical analysis services to the Centre.

Progress: Administrative and clerical services including handling correspondence and purchase documents were provided to the Wing. Transcribing and handling various reports was a major research support responsibility. Research design and data analysis services were provided to Centre staff as required. A biometrician helped research staff plan and design studies, reviewed study proposals for statistical acceptability and participated in the processing and interpretation of data.

Program: ADMINISTRATIVE SERVICES
- CHEMISTRY WING

Objectives: To administer and manage the Wing and to support the Wing's programs.

Progress: Administrative staff secured supplies, services and capital equipment for the Wing. As well, staff processed and distributed some 15,000 chemical analysis reports involving some 350,000 chemical analyses and investigations.

Program: ADMINISTRATIVE SERVICES
- COMMON SERVICES WING

Objectives: To provide support to programs that are common to the Centre.

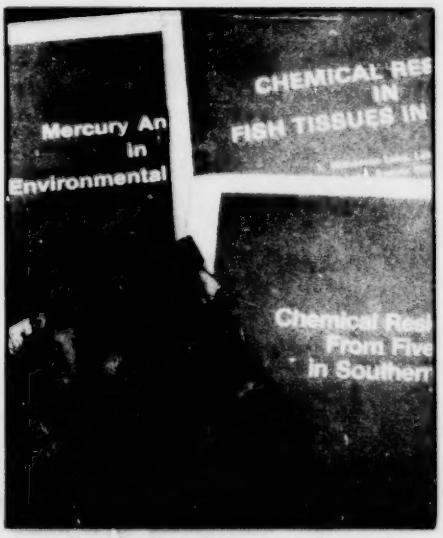
Progress: The Centre's major administrative needs were met through the Common Services Wing's four Sections - Financial Services, Personnel Services, Information Services and Communications.

Senior management staff were involved with the preparation of budget documents and the monitoring and expenditure of funds from the $11.5-million budget. In addition to assisting with the budgeting process, the Financial Services Section operated a central warehouse, central duplicating facility and provided central purchasing controls, an accounts payable system, interim forecasting reports, contract control and some budget automation.

Recruitment and staff relations and training were among the services provided by the Personnel Services Section. A new occupational health program was started, and an emergency response team was established to deal with emergencies.

The Centre Library, operated by the Information Services Section, continued its central role in scientific investigations through services such as manual and computer-assisted reference searches and collection development. Approximately 100 in-depth, on-line computer searches were performed. The Section also processed mail and indexed and classified Centre documents and correspondence.

Various public relations and printing services were provided by the Communications Section. Several special events were organized including an Open House which attracted over 500 people, and participation in the Vegreville Fair. Over 700 people were given guided tours of the Centre. The Section assisted with 54 staff printing projects, produced an Annual Review and a monthly internal newsletter and recorded 46 contacts with news media.



A number of technical reports and extension publications were produced.

Program: ADMINISTRATIVE SERVICES - ENVIRONMENTAL TECHNOLOGY WING

Objectives: To further Wing goals by providing general administrative services, professional development and development and maintenance of facilities.

Progress: In addition to general administrative services provided to the Wing, this program maintained or developed facilities including five laboratories, water treatment plants, an incineration research facility, and pilot plant workspaces. The Wing devoted considerable time to management, professional, technical and clerical training activities and to assessing the feasibility of potential new projects.

Program: ADMINISTRATIVE SERVICES - PLANT SCIENCES WING

Objectives: To provide administrative support for the research and service programs of the Plant Sciences Wing.

Progress: The hiring of Soils and Vegetation Group Heads was a major addition to the Wing's permanent staff list of 25. Program development in these two areas was started. During the busy field season, up to 22 temporary staff members were employed. Facility development included the acquisition of new growth chambers bringing the investment in these chambers to around one million dollars.

Program: CAPITAL FACILITY DEVELOPMENT

Objectives: To plan and develop physical facilities required for the Centre.

Progress: Major development projects during the year included a start on construction of the inhalation toxicology containment laboratory and work on unfinished laboratory space. Plans were also completed and funds approved for construction of a pilot scale waste handling incinerator building.

Program: SITE SUPPORT SERVICES

Objectives: To provide manpower, equipment, facilities and materials needed to support research work and to operate and maintain the site and related facilities.

Progress: Site support staff managed the 750-acre (300-hectare) site in Vegreville as well as off-site field base camps. This included management of on-site cultivated land, plot land for crop research, wild and domestic animal housing and paddocks and liquid waste lagoons. Sixty acres (24 hectares) of shelterbelt and a 10-acre (four-hectare) tree nursery were maintained and developed. Equipment including farm implements, off-road vehicles, and a fleet of cars and trucks was maintained.

Program: TECHNICAL SERVICES

Objectives: To deliver projects, services and facilities required for computing support at the Centre.

Progress: A plan outlining the Centre's computer needs was developed, leading to a decision to acquire an on-site computer. The top priority electronic data processing requirement was identified as laboratory information management in the Chemistry Wing. The mainframe computer was acquired late in March.

ALBERTA ENVIRONMENTAL CENTRE
PROGRAM/PROJECT LISTS 1983/84

PROGRAM	PROJECT/SUB-PROJECT	CLIENT AGENCY
Analytical Services (Air)	Analytical Services (Air)	Environment
Analytical Services (Water)	Analytical Services (Water) Precipitation Studies (Water)	Health Units, Energy and Natural Resources, Environment
Animal Resources	Laboratory Animal Services Livestock Services	Alberta Environmental Centre
Aquatic Biology	Fish Maintenance Water Treatment System Heavy Metals in Natural Waters: Vol. 1 Vol. 2 Fish Mortality Investigations	Energy and Natural Resources, Environment
Aquatic Habitat Studies	Effects of Forestry on Fisheries Resources (Tri-Creek Study)	Energy and Natural Resources, Environment
Aquatic Toxicology	Biological Monitoring of Industrial Effluents Toxicology of Pulp Mill Effluents (Proctor & Gamble) Toxicology of Coal Mine Flocculant (Luscar Coal Mine) Fractionation of Fertilizer Plant Effluents (Sheritt Gordon Study) Toxicity of Tar Sands Holding Pond Effluents	Energy and Natural Resources, Environment
Chemical Residues in Alberta Waters	Chemical Residues in Fish Tissues Polycyclic Aromatic Hydrocarbons in Athabasca River Fish Mercury in Alberta Fish Mercury Uptake Studies Metal Speciation in Fish Sources of Mercury in Southern Alberta Rivers	Energy and Natural Resources, Agriculture, Environment
Chemical Safety Evaluation	Chemical Safety Evaluation	Agriculture, Energy and Natural Resources, Workers' Health, Safety and Compensation, Environment
Controlled Environment	Growth Chambers	Alberta Environmental Centre
Environmental Chemistry of Wastewater	Agents of Environmental Concern Identification of Toxic Fraction(s) of Wastewater	Energy and Natural Resources, Environment
Environmental Impact on Soil Ecology	Environmental Impact on Soil Ecology	Energy and Natural Resources, Agriculture, Environment
Ecological Toxicology	Chemical Residues in Colonial Nesting Birds Peregrine Falcons	Energy and Natural Resources
Effects of Environmental Sulphur	Effects of Environmental Sulphur on Livestock	Agriculture, Environment
Environmental Physiology	Swan Hills Moose Browse Study Game Ranching Research	Energy and Natural Resources, Agriculture
Forestry Development & Wildlife Resources	Industrial Development and Wildlife in The Boreal Forest Application of Remote Imagery to Wildlife Habitat Classification	Energy and Natural Resources, Environment
Genetic Toxicology	Genetic Toxicology Reproductive Toxicology	Environment
Geochronology Services	Development of Geochronology Services	Alberta Research Council, Agriculture, Archaeological Survey of Alberta, Environment
Humane Trapping Research	Humane Trapping Research	Energy and Natural Resources, Agriculture, Fur Institute of Canada, Environment
Inhalation Toxicology	Inhalation Toxicology Development Health Effects of Sulphur Gases	Workers' Health, Safety and Compensation, Agriculture
Insect Pest Management Research & Development	Special Crops Insect Pest Management Field Crop Insect Pest Management Livestock Insect Pest Management	Agriculture
Instrumentation Services	Maintenance of Laboratory Instruments Engineering and System Design	Alberta Environmental Centre
Lake Nutrients	Lake Nutrients	Environment
Microbiological Identification Services	Microbiological Identification Services	Alberta Environmental Centre

Microbiological Processes in Waste Management	Survey of Feedlot Wastes Toxic Wastes and Microbial Metabolism Cellulose Biotechnology Landfill Microbiology	Agriculture, Alberta Research Council, Alberta Environmental Centre, Environment
Native Species for Reclamation - Research & Development	Native Species for Reclamation R & D	Reclamation Research Technical Advisory Committee Cooperating Agencies, Environment
Nutrition Services	Nutrition Analysis Nutrition Formulation	Alberta Environmental Centre
Pathology Services	Necropsy Services Histology and Histopathology Clinical Pathology Services Ultrastructural Pathology Services	Alberta Environmental Centre
Pest Management, Diagnostic and Extension Services	Insect Diagnostic and Extension Services Plant Disease Diagnostic and Extension Services Weed Diagnostics and Extension Services	Agriculture, Health Units, Environment
Pesticide Analysis and Methods Development	Health Units Pollution Control Division	Agriculture, Health Units, Alberta Environmental Centre, Environment
Plant Pathology Research and Development	Disease Management in Cereal, Oilseeds and Special Crops Disease Management in Forage Crops Disease Management in Woody Ornamentals, Shelterbelts and Turf	Agriculture
Physical/Chemical Processes in Waste Management	Emission Control Technology Incineration Fixation of Wastes	Energy and Natural Resources, Agriculture, Environment
Precipitation Studies	Precipitation Studies (Air) Precipitation Studies (Water)	Environment
Problem Wildlife	Diagnostic & Field Investigation Services Pocket Gopher Study Coyote Predation of Lambs Chemical Control of Problem Wildlife	Agriculture
Quality Control & Data Management	Quality Control & Data Management	Energy and Natural Resources, Health Units, Environment
Research Services - Chemistry	Health Units Pollution Control Division	Alberta Environmental Centre
Site Environmental Services	Site Environmental Services	
Soil Analytical Services	Soil Analytical Services	Agriculture, Energy and Natural Resources, Environment
Soil Reclamation Research	Sodic Spoil Behaviour Compaction and Plant Growth Rights of Way	Agriculture, Energy and Natural Resources, Environment
Technical Support Services	Health Units Alberta Environment Pollution Control Division Alberta Environmental Centre Others Alberta Agriculture	Social Services and Community Health Environment
Toxicology of Biocides	Toxicology of Pesticides	Energy and Natural Resources, Workers' Health, Safety and Compensation, Environment
Toxicology of Petrochemicals and Fossil Fuels	Toxicology of Petrochemicals and Fossil Fuels	Agriculture
Toxicology Services	Toxicology Services Toxicology Information Services	Agriculture, Energy and Natural Resources, Workers' Health, Safety and Compensation, Environment
Trace Organic Analysis and Methods Development	Health Units Pollution Control Division	Agriculture, Energy and Natural Resources, Health Units, Alberta Environmental Centre, Environment
Water Quality Improvement	Effects of Pulp Mill Effluents on Potable Water Mobile Water Treatment Plant Development	Environment
Weed Management Research and Development	Herbicides and Chemical Control of Weeds Weed Biology and Ecology Biological Control of Weeds	Agriculture
Wildlife Biology Services	Wildlife Biology Services Moose Mortality Study	Agriculture, Energy and Natural Resources, Alberta Environmental Centre, Environment

STAFF ROSTER
(March 31, 1984)

EXECUTIVE DIRECTOR:
R. Sherman Weaver, Ph.D. (McGill)
ASSISTANT DIRECTOR:
J. D. Taylor, Ph.D. (Saskatchewan)

COMMON SERVICES WING
HEAD; Stan Selinger, B.Comm. (Calgary)
PROFESSIONAL STAFF:
Baynish Bassett, B.A. (Saskatchewan)
Jim Bradley, B.Sc. (Alberta)
Michael Casselman, Ph.D. (Dalhousie)
Gerald Kerr, MLS (Western Ontario)
Herb King, B.Comm. (Alberta)
Diana Lee, MLS (Alberta)
Fran Mahé, RN
Mary Jane Neville, MLS (McGill)
Jane Sadell
TECHNICAL STAFF:
Susan Evans
Audrey Lyons
Robert MacInnes
Duane Watrin
Dan Wittmeier
CLERICAL STAFF:
Sylvia Baranec
Pauline Degenstein
Pat Ferleyko
Ken Friebe
Mary Ann Fried
Earl Hawryluk
Loretta Hodge
Gloria Horon
Kathy Ilkiw
Eileen Iwaskow
Sophie Korpan
Marianne Kostyniuk
Joy Martynuik
Darlene McArthur
John McLeod
Dianna Nikoleychuk
Connie Noselski
Sharon Novakowski
Cathy Olineck
Ron Robinson
Leta Sokoluk
Melanie Thibault
Madeleine Thomlinson
Denise Toma
Dixie Warren
Wendy Wowdzia
Annette Yaremchuk
Lauren Zukiwski

ENVIRONMENTAL TECHNOLOGY WING
HEAD: Malcolm Wilson, Ph.D. (London)
PROFESSIONAL STAFF:
David Arnold, Ph.D. (Arizona)
Atif Boni, M.Sc. (Delft)
Stephen Davies, Ph.D. (Western Ontario)
David Dugle, Ph.D. (Alberta)
Peter Hannak, P.Eng. (Budapest)
Andrew Kamela, Ph.D. (Kracow)
Tadeusz Kazmierczak, M.Sc. (Warsaw)
Paul Layte, M.Sc. (Cranfield)
Albert Liem, Ph.D. (McMaster)
Richard Milner, B.Sc. (Alberta)
Bhaskaran Pandompatam, Ph.D. (Concordia)
Swami Ramakrishnan, M.Eng. (McGill)
Albert van Roodselaar, Ph.D. (Alberta)

TECHNICAL STAFF:
Fred Becker
Tom Charity
Leslie Dowdell, M.Sc. (Simon Fraser)
Alberto Fiacco
Richard Frenette, B.Sc. (Sherbrooke)
Heather Hill
Richard Komick
Leon Koverny
Kim Layne, B.Sc. (Guelph)
Hugh Mack
Dave Mewis
Russ Modiem
Charles Montandon
Richard Nutbrown
John Vogrinetz, B.Sc. (Western Ontario)
CLERICAL:
Barb Anderson
Barb Demare
Connie Gizowski

ANIMAL SCIENCES WING
HEAD: Leonard E. Lillie, Ph.D. (Purdue)
PROFESSIONAL STAFF:
Mudher Albassam, Ph.D. (Purdue)
Morley Barrett, Ph.D. (Alberta)
Antoinette Chovelon, M.Sc. (Alberta)
John Craig, Ph.D. (London)
Alexander Hawley, Ph.D. (Saskatchewan)
Yumiko Hoyano, Ph.D. (Alberta)
Aziz Khan, Ph.D. (Lucknow)
William Lake, B.Sc. (Manitoba)
James Moore, Ph.D. (Bath)
John Nagy, B.Sc. (Lethbridge)
Tom Osimitz, Ph.D. (Michigan)
Michael Prior, Ph.D. (Saskatchewan)
Subramanian Ramamoorthy, Ph.D. (Madras)
Laurence Roy, M.Sc. (Idaho)
Arvind Sharma, Ph.D. (Guelph)
James Somers, Ph.D. (Guelph)
TECHNICAL STAFF:
Karen Blumhagen
Jack Demare
Karen Cooper
Toni Gellings
Lee George
Bernard Goski
Carole Gubbels
Clare Gulayets
Doris Bailey
Alfred Kolenosky
Marlene Lefebvre
Elizabeth McGuinness
Marja Morwood-Clark
Dave Nelson
Jack Nolan
Michele Schuler, B.Sc. (Alberta)
Kevin Smiley
Kathleen Wilson, B.Sc. (Carleton)
Shirley Yong, M.Sc. (Alberta)
CLERICAL STAFF:
Fran Dugle
Arhlene Hrynyk
Carmen McClusky
Charlene Melnyk
Patricia O'Shea
Anne Walker

CHEMISTRY WING
HEAD: John G. Hardy, Ph.D. (Alberta)
PROFESSIONAL STAFF:
Ijaz Ahmad, Ph.D. (Waterloo)
Henry Bertram, B.Sc. (Alberta)
Rakesh Bhatnagar, M.Sc. (Saskatchewan)
Richard Coleman, Ph.D. (Alberta)
Nirmal Das, Ph.D. (Ottawa)
Fred Dieken, Ph.D. (Victoria)
Lydia Goatcher, Ph.D. (Maryland)
Lorne Goodwin, B.Sc. (British Columbia)
John Headley, Ph.D. (Warwick)
Merl Korchinski, B.Sc. (Saskatchewan)
Yogesh Kumar, Ph.D. (New Brunswick)
James Miller, M.S. (Alaska)
Ansar Qureshi, Ph.D. (New Brunswick)
Dean Smillie, Ph.D. (British Columbia)
TECHNICAL STAFF:
Norman Arbon
Peter Bertolini
Warren Bilida, B.Sc. (Windsor)
Colin Cathrea
David Chalupa
Orest Chayka, B.Sc. (Saskatchewan)
Brenda Chow
Bruce Christensen
John Dach
Donna Francom
Irene Gaudet, B.Sc. (Alberta)
Lawrence Geleta
Don Goebel
Ibolya Hannak
Rosemary Harris
Cindy Horon
Alan Hrynyk
Dave Humphries
Melanie Jolicoeur
Barbara Kovacevich
Debbie Laderoute
Debra Langier
Ernie Leitz
Fred McClusky
Brad Morris
Arlene Oatway
Randy Norton, B.Sc. (McGill)
John Paran, B.Sc. (Alberta)
Grant Prill
Ruth Prill
Brian Serink
Heather Shandro
Shyama Sharma, B.A. (Delhi)
Diana Smathers
Diana Spasiuk
Ernest Theophilus, B.Sc. (Punjab)
Karen These
Marie Twine, B.Sc. (Guelph)
Larry Uchman
Alessandro Urso
Angela Wharmby, B.Sc. (Sussex)
Adolph Wittmeier
CLERICAL STAFF:
Cliff Bezaire
Kay McCaffrey
Holly Palley
Susan Stecyk
Edna Stefanik

PLANT SCIENCES WING
HEAD: Bart Bolwyn, Ph.D. (Oregon State)
PROFESSIONAL STAFF:
Surya Acharya, Ph.D. (Saskatchewan)
Chin Chu, M.Sc. (Alberta)
Gil Flores, Ph.D. (Toronto)
Reinhard Hermesh, M.Sc. (Saskatchewan)
Richard Johnson, M.Sc. (Saskatchewan)
Prem Kharbanda, Ph.D. (Illinois)
Helen Liu, Ph.D. (Guelph)
Alexander McClay, Ph.D. (Cambridge)
Martin Mugala, M.Sc. (Saskatchewan)
John O'Donovan, Ph.D. (Cork)
Hugh Philip, M.Sc. (Alberta)
Fayyaz Qureshi, Ph.D. (London)
Paul Sharma, Ph.D. (Alberta)
Marilyn Steiner, B.Sc. (Bath)
Rina Varma, Ph.D. (Alberta)
Gerald Wheeler, M.Sc. (Alberta)
TECHNICAL STAFF:
Shaun Allen, B.Sc. (Alberta)
James Antoniuk
Tim Clermont
Leslie Dietz, B.Sc. (Saskatchewan)
Harold Feddema
Marion Herbut
Mumtaz Qureshi, M.Sc. (Faisalabad)
Rita Stevens
Hilary Wilkinson
CLERICAL STAFF:
Karolyn Calder
Joan Romaniuk
Lorraine Yakemchuk

SITE SUPPORT SERVICES
HEAD: Arne Aasen, M.Sc. (Alberta)
PROFESSIONAL STAFF:
Gary Lofthaug, B.Sc. (Alberta)
TECHNICAL STAFF:
Flo Bilyk
Peter Conway
Joe Nowak
Len Nowak
Harvey Schultz
Don Turchin
CLERICAL STAFF:
Conna McCarty

PUBLIC WORKS, SUPPLY AND SERVICES

PROPERTY MANAGEMENT DIVISION
SUPERINTENDENT: Marshal Palichuk
Joe Charchun
Peter Clement
Bill Czar
June Doolittle
Jean Dussome
Paul Godziuk
Don Henderson
Dave Kindrachuk
Berna Kirechuk
John Kirechuk
Henry Kostyniuk
Keith Kreamer
Janet Monteith
Lucille Nowak
Gordon Rennie
Peter Rubuliak
Ed Rudyk
Harry Sawchuk
Helen Toma
Bill Towpitch
Brad Tymchuk
Walter Tymchuk
Jim Zuk

STAFF COMMITTEE MEMBERSHIPS

Alberta Agriculture, Agrometeorology Advisory Committee
Alberta Climate Advisory Committee
Alberta Environment Committee on Acid Deposition
Alberta Environment Executive Committee
Alberta Environment Finance and Administration Committee
Alberta Environment Hazardous Chemicals Advisory Committee
Alberta Environment Records Management Committee
Alberta Environment War Emergency Measures Committee
Alberta Forage Crop Advisory Committee
Alberta Government Libraries Council
Alberta Institute of Agrologists, Registration Committee
Alberta Petroleum Industry - Government Environmental Committee
Alberta Pest Control Advisory Committee
Alberta Veterinary Medical Association, Council
Alberta Warble Control Advisory Committee
Alberta Weed Advisory Committee and Research Sub-committee
Alberta Wildlife Production Committee
American College of Veterinary Pathologists
American Public Health Association, Standard Methods Committee
American Society for Testing and Materials, Microbiological Methods Committee
American Veterinary Medical Association
Black Fly Control Steering Committee
Cabinet Advisory Committee on Science and Research
Canadian Feed Association
Canadian Pest Management Society
Canadian Plant Disease Survey Liaison Committee
Canadian Society of Laboratory Technologists, Examination Panel
Canadian Society of Microbiologists, Board of Directors
Canadian Veterinary Medical Association, National Examining Board
Dutch Elm Disease Advisory Committee
Energy Resources Conservation Board and Lodgepole Inquiry Panel
Environmental Horticulture Advisory Committee
Expert Committee on Grain Diseases, Chemical Control Sub-committee and Oilseeds and Special Crop Sub-committees
Expert Committee on Weeds, Biological Control Sub-committee and Research Appraisal and Planning Committees
Federal Long-Range Transport of Air Pollutants (LRTAP) Studies
Federal/Provincial Committee to Prepare Compendium of Methods Used in Canada for the Analysis of Drinking Water
Horticulture Extension Advisory Committee
Institute for Research on Public Policy
International Association for Humic Substances
Journal of Freshwater Ecology, Associate Editor
Lakeland College Evaluation Committee and Advisory Committee on Conservation and Technology Programs
Lakeland College Secretarial Arts Advisory Committee
Microscopial Society of Canada, Alberta Section
Mount Royal College Advisory Committee, Chemical Technology Programs
Northern Alberta Institute of Technology Advisory Committee, Chemical Technology Programs
Northern Alberta Institute of Technology Biological Science Program Advisory Committee
National Health, Research and Development Program, Project Reviewer
National Science and Engineering Research Council of Canada, Panel on Strategic Grants in Environmental Toxicology
Plains Coal Crop and Soil Sub-committee Reclamation Research Program
Plains Hydrology Reclamation Project Geochemistry Sub-committees
Prairie Provinces Water Board and Task Force on Analytical Methodologies, Sub-committee on Water Quality
Reclamation Committee of the Industrial Vegetation Management Association of Alberta
Reclamation Research Technical Advisory Committee
Red Deer College Advisory Committee, Chemical Technology Programs
Second International Symposium on Toxicity Testing Using Bacteria, Symposium Committee
Society of Toxicology of Canada, Education and Nomination Committees
Toxicity Assessment Bulletin, Editorial Board
University of Alberta Graduate Student Supervisory Committee
University of Alberta Horticulture Program Advisory Committee
University of Alberta Student Advisory Committee
University of Calgary Student Advisory Committee
University of Guelph Graduate Student Supervisory Committee
Water Pollution Research in Canada, Associate Editor
Western Committee on Crop Pests, Household and Greenhouse Crop Sub-committees and Oilseeds Sub-committees
Western Committee on Livestock Pests
Western Committee on Plant Disease Control and Sub-committee on Diseases of Greenhouse Crops
Wildlife Disease Meeting, Planning Committee
Wildlife Society, Professionalism Committee

JOURNAL ARTICLES

Ahmad, I. 1983. On-line trace enrichment of Difenzoquat in water and its determination by HPLC. J. Environ. Sci. Health. B18(2):207-219.

Ahmad, I. 1983. Rapid method for extraction and reverse phase liquid chromatographic determination of Paraquat residues in water. J. Assoc. Off. Anal. Chem. 66:663-666.

Aquatic Biology Group. 1984. Pesticide and PCB levels in fish from Alberta (Canada). Chemosphere. 13(1):19-32.

Coleman, R. N. and Paran, J. H. 1983. Accumulation of hexavalent chromium by selected bacteria. Environ. Technol. Lett. 4:149-156.

*Craig, J. F. and Kipling, C. 1983. Reproduction effort versus the environment; case histories of Windermere perch and pike. J. Fish Biol. 22:713-727.

Dorrance, M. J. 1983. A philosophy of problem wildlife management. Wildl. Soc. Bull. 2(4):319-324.

*Flores, G., Swanson, T., Sumar, S. and Howard, R. J. 1983. Determining yield losses caused by fusarium root rot in processing pea and bean fields in Southern Alberta. Can. J. Plant Pathol. 5(3):204-205.

*Flores, G. and Hubbes, M. 1983. Phytoalexin elicitation in Populus tremuloides Michx. by biotic and abiotic stress factors. Can. J. Plant Pathol. 5(3):204.

*Hawley, A. W. L., Sylven, S. and Wilhelmson, M. 1983. Commercial moose meat production in Sweden. Livestock Production Science. 10:507-516.

Kumar, Y. 1983. Reverse phase high performance liquid chromatographic determination of Baygon in water. J. Environ. Sci. Health. B18(6):757-765.

Liu, H. J. and Liu, T. P. 1984. Sensilla on the antennal flagellum of the Bertha armyworm moth, Mamestra configurata Wlk. (Lepitoptera:Noctuldae): a scanning electron microscope study. Ann. Entomol. Soc. Am. 77:236-245.

*McClay, A. S. 1983. Biology and host-specificity of Stobaera concinna (Stal) (Homoptera: Delphacidae), a potential biocontrol agent for Parthenium hysterophorus L. (Compositae). Folia Entomologica Mexicana. 56:21-30.

*McEwan, F. L. Ritcey, G., and Liu, H. J. 1984. Laboratory studies of radiation-induced sterility on the onion maggot, Delia Antiqua (Diptera;Anthomyiidae). Can. Entomol. 116:119-122.

*O'Donovan, J. T., O'Sullivan, P. A., and Caldwell, C. D. 1983. Basis for antagonism of Paraquat phytotoxicity to barley by MCPA dimethylamine. Weed Res. 23:165-172.

*O'Sullivan, P. A., O'Donovan, J. T., and Weiss, G. M. 1983. Influence of stage of application of Glyphosate and Paraquat with and without Tween 20 on the control of annual grass species. Can. J. Plant Sci. 63:1039-1046.

Ramamoorthy, S. and Morgan, K. 1983. Physicochemical speciation of toxic fractions of wastewaters. Reg. Tox. and Pharm. 3(2):172-177.

*Sharma, A. K., Rodriguez, L. A., Mekonnen, C. J., Wilcox, C. J., Bachman, K. C. and Collier, R. J. 1983. Climatological and genetic effects on milk composition and yield. J. Dairy Sci. 66:119.

*Sharma, M. P., McBeath, D. K , and Vanden Born, W. H. 1983. Effect of fall and spring tillage on wild oat germination. Can. J. Plant Sci. 63:561-562.

*Sharma, M. P. and Vanden Born, W. H. 1983. Crop competition aids efficacy of wild oat herbicides. Can. J. Plant Sci. 63:503-507.

*Stock, T. M. and Barrett, M. W. 1983. Helminth parasites of the gastrointestinal tracts and lungs of moose (Alces alces) and wapiti (Cervus elaphus) from Cypress Hills, Alberta, Canada. Proc. Helminthol. Soc. Wash. 50(2):246-251.

*Experimental work done elsewhere

OTHER PUBLICATIONS

Aquatic Biology Group. 1984. Chemical residues in fish from five rivers in southern Alberta. Alberta Environmental Centre, Vegreville. AECV83-R5. 41 p.

Aquatic Biology Group. 1983. Pesticides and PCB's in the North Saskatchewan River and Red Deer River. Alberta Environmental Centre, Vegreville. AECV83-R4. 47 p.

Arnold, L. David. 1983. An approach to low-level H-3 and C-14 analysis at the Alberta Environmental Centre. IN: McQuarrie, S. A., Ediss, C., and Wiebe, L. I. (eds). Advances in Scintillation Counting. University of Alberta, Edmonton, Alberta. 442-455.

Duczek, L. J., and Kharbanda, P. D. 1983. Effect of seed treatment fungicides on emergence, common root rot and yield of cypress spring wheat. Pesticide Research Report, Expert Committee on Pesticide Use in Agriculture. 299.

Flores, G. 1983. The effect of sulfur on yield of alfalfa and control of "alfalfa sickness". Pesticide Research Report, Agriculture Canada. 264.

Flores, G. and Allen, S. 1983. Susceptibility of certain oilseed crops to Verticillium albo-atrum from alfalfa. A preliminary report. Proc., Fourth Annual Meeting, Plant Pathology Society of Alberta, Brooks. 42.

*Kingsley, M. C. S., Nagy, J. A. and Russell, R. M. 1983. Patterns of weight gain and loss for grizzly bears in northern Canada. Int. Conf. Bear Res. and Manage. 5:174-178.

Kharbanda, P. D. and Stevens, R. R. 1983. Evaluation of seed treatment fungicides for control of damping-off of canola. Pesticide Research Report, Agriculture Canada. 234. AHRC pamphlet 83-16.

*Kharbanda, P. D. 1983. Fusarium diseases of greenhouse crops in Alberta. Proceedings, Fusarium Identification Workshop, Brooks.

Kharbanda, P. D. and Stevens, Rita. 1983. Noteworthy diseases of cereals and oilseed crops in northeastern Alberta in 1983. Proceedings, Fourth Annual Meeting, Plant Pathology Society of Alberta. Brooks. 43.

Lee, D. W., Prior, M. G. and Sharma, R. M. 1983. Toxicological and safety aspects of H_2S and SO_2: a bibliography. Alberta Environmental Centre, Vegreville. AECV83-L2. 88 p.

Lillie, L. E. 1983. Biomedical effects of sulphur containing emissions. Proceedings of symposium on the effects of sour gas on wildlife, June 3, 1981. University of Calgary. Faculty of Environmental Design. 9-36.

Lillie, Leonard E. 1983. Aquatic toxicology - Quo Vadis? Proceedings of Ninth Annual Aquatic Toxicology Workshop, Edmonton. Can. Tech. Rep. Fish Aquat. Sci. 1162.

Liu, H. J. 1983. Sequential sampling for Bertha armyworm in canola. Annual meeting, Entomological Society of Canada, Regina.

Moore, J. W. and Ramamoorthy, S. 1984. Heavy Metals in Natural Waters: Applied Monitoring and Impact Assessment. Springer-Verlag (New York). 268 pp.

*Nagy, J. A., Russell, R. H., Pearson, A. M., Kingsley, M. C. S. and Goski, B. C. 1983. Ecological studies of grizzly bears in the Arctic Mountains, Northern Yukon, 1972 to 1975. Canadian Wildlife Service Report. 104 pp.

*Nagy, J. A., Russell, R. H., Pearson, A. M., Kingsley, M. C. S. and Larsen, C. B. 1983. A study of grizzly bears on the barren grounds of Tuktoyaktuk Peninsula and Richards Island, Northwest Territories, 1974 to 1978. Canadian Wildlife Service Report. 136 pp.

O'Donovan, J. T. 1983. Influence of relative time of emergence of wild oats relative to barley and wheat on yield of barley and wheat. Research Report, Expert Committee on Weeds (Western Canada). 280.

O'Donovan, J. T. 1983. Influence of time of emergence of wild oats relative to barley and wheat on yield of barley and wheat. Research Report, Expert Committee on Weeds (Western Canada). 279-280.

O'Donovan, J. T. 1983. Influence of various densities of tartary buckwheat on yield of barley and wheat. Research Report, Expert Committee on Weeds. (Western Canada). 279.

O'Donovan, J. T. and Sharma, M. P. 1983. Wild oats, competition and crop losses. Wild Oat Action Committee. Proc. Regina. 27-37.

Philip, H. G. and Herbut, M. J. 1983. Control of horn flies using cypermethrin-impregnated ear tags. Pesticide Research Report. Agriculture Canada. 187.

Philip, H. G. and Herbut, M. J. 1983. Control of horn flies using permethrin-impregnated ear tags and strips. Pesticide Research Report, Agriculture Canada. 188.

Philip, H. G. and Herbut, M. J. 1983. Effectiveness of Bovaid ear tags for horn fly control during second season of use. Pesticide Research Report, Agriculture Canada. 189.

Philip, H. G. and Herbut, M. J. 1983. Control of horn flies by application of Bovaid ear tags to nursing calves. Pesticide Research Report, Agriculture Canada. 189.

Philip, H. G. and Herbut, M. J. 1983. Control of horn flies using permethrin tapes attached to tails or to ear tags. Pesticide Research Report, Agriculture Çanada. 191.

Philip, H. G. and Herbut, M. J. 1983. Effectiveness of 0.5% fenvalerate ready-to-use backrubber solution for horn fly control. Pesticide Research Report, Agriculture Canada. 192.

Philip, H. G. 1983. Incidence of swine mange, Sarcoptes scabiei (De Geer) in Alberta. Proc., Joint Meeting of the Entomological Societies of Alberta and B.C. Penticton, B.C.

Piening, L. J., Conner, R., Davidson, J. G. N., Duczek, L. J. and Kharbanda, P. D. 1983. Seed treatment for the control of common root rot in barley. Pesticide Research Report, Expert Committee on Pesticide Use in Agriculture. 266.

Piening, L. J., Conner, R., Davidson, J. G. N., Duczek, L. J. and Kharbanda, P. D. 1983. Seed treatment for the control of loose smut of barley - 1983. Pesticide Research Report, Expert Committee on Pesticide Use in Agriculture. 274.

Prior, Michael. 1983. Aquatic toxicology - Where do we go from here? Proceedings of Ninth Annual Aquatic Toxicology Workshop, Edmonton. Can. Tech. Rep. Fish Aquat. Sci. 1162.

Prior, M. G. 1983. Training in toxicology: a government perspective. Proc. 26th Ann. Mtg. Can. Fed. Biol. Soc. Ottawa.

Qureshi, F. A. and Feddema, H. L. 1983. Four abstracts on wild oat and broadleaved weed control in wheat. Research Report, Expert Committee on Weeds (W. Canada). 1:47-49.

Qureshi, F. A. and Feddema, H. L. 1983. Tolerance of wheat varieties to broadleaved and wild oat herbicides. Research Report, Expert Committee on Weeds (W. Canada). 1:49-50.

Qureshi, F. A. and Feddema, H. L. 1983. Nine abstracts on tolerance of barley varieties to broadleaved and wild oat herbicides. Research Report, Expert Committee on Weeds (W. Canada). 1:135-140.

Qureshi, F. A. and Feddema, H. L. 1983. Two abstracts on control of wild oats and green foxtail in canola. Research Report, Expert Committee on Weeds (W. Canada). 1:333-334.

Qureshi, F. A. and Feddema, H. L. 1983. Effects of adjuvants on efficacy of CGA82725. Research Report, Expert Committee on Weeds (W. Canada). 1:334.

Qureshi, F. A. and Feddema, H. L. 1983. Control of grassy and broadleaved weeds in canola. Research Report, Expert Committee on Weeds (W. Canada). 1:335.

Qureshi, F. A. and Feddema, H. L. 1983. Control of volunteer barley in wheat. Research Report, Expert Committee on Weeds (W. Canada). 2:593.

Qureshi, F. A. and Feddema, H. L. 1983. Effects of adjuvants on efficacy of DPXT6376. Research Report, Expert Committee on Weeds (W. Canada). 2:599.

Qureshi, F. A. and Feddema, H. L. 1983. Two abstracts on broadleaved weed control in wheat. Research Report, Expert Committee on Weeds (W. Canada). 2:600-601.

Sharma, M. P. 1983. Low rates of sethoxydim and fluazifop butyl on wheat. Research Report, Expert Committee on Weeds (W. Canada). 1:60.

Sharma, M. P. 1983. Broadleaf weed control in canola. Research Report, Expert Committee on Weeds (W. Canada). 1:336.

Sharma, M. P. 1983. Control of tartary buckwheat in barley. Research Report, Expert Committee on Weeds (W. Canada). 2:601.

*Somers, J. D., Gilbert, F. F., Brooks, R. J., and Joyner, D. E. 1983. Chemical control of depredating blackbirds in Ontario field corn. Proc. Ninth Bird Control Semin., Bowling Green, OH. 9:225-232.

Steiner, M. Y. 1983. Cruciferous root maggot control for home gardens. Pesticide Research Report, Agriculture Canada. 138.

Steiner, M. Y. 1983. Evaluation of Avermectin and Trigard for chrysanthemum leafminer control. Pesticide Research Report, Agriculture Canada. 198.

Steiner, M. Y. 1983. Evaluation of Avermectin for greenhouse whitefly control on cucumbers. Pesticide Research Report, Agriculture Canada. 199.

Swanson, T. A., Howard, R. J., Flores, G. H. A., and Sumar, S. P. 1983. Explaining crop losses in processing peas in Southern Alberta with particular reference to root rot. Western Committee on Crop Loss Assessment (WRCC 28). Bulletin on crop losses.

Swanson, T. A., Flores, G. H. A., and Howard, R. J. 1983. Studies of pulse crop diseases in southern Alberta in 1982. AHRC pamphlet 83-5.

Varma, R. 1983. Report on important diseases in northeastern Alberta in 1983. Proceedings, Fourth Annual Meeting, Plant Pathology Society of Alberta, Brooks. 40-41.

*Experimental work done elsewhere

BOARD OF DIRECTORS*

Mr. W. Solodzuk (Chairman)
Deputy Minister
Alberta Environment
14th Floor, Oxbridge Place
9820 - 106 Street
EDMONTON, Alberta

Dr. H. Buchwald
Managing Director
Occupational Health & Safety Division
Alberta Workers' Health, Safety & Compensation
5th Floor, Donsdale Place
10709 - Jasper Avenue
EDMONTON, Alberta

Mr. E. E. Kupchanko
Assistant Deputy Minister
Environmental Protection Services
Alberta Environment
14th Floor, Oxbridge Place
9820 - 106 Street
EDMONTON, Alberta

Mr. F. W. McDougall
Deputy Minister
Renewable Resources
Alberta Energy & Natural Resources
9915 - 108 Street
EDMONTON, Alberta

Dr. A. Olson
Assistant Deputy Minister
Research & Operations
Alberta Agriculture
J. G. O'Donoghue Building
7000 - 113 Street
EDMONTON, Alberta

Dr. R. Stewart
President
Alberta Research Council
Executive Offices
7th Floor, Terrace Plaza
4445 - Calgary Trail South
EDMONTON, Alberta

Dr. R. S. Weaver
Executive Director
Alberta Environmental Centre
P.O. Bag 4000
VEGREVILLE, Alberta

TECHNICAL ADVISORY COMMITTEE*

Dr. R. Christian (Chairman)
Director, Animal Health Division
Alberta Agriculture
J. G. O'Donoghue Building
7000 - 113 Street
EDMONTON, Alberta

Mr. R. R. Andrews
Director, Wildlife Management
Fish & Wildlife Division
Alberta Energy & Natural Resources
5th Floor, Bramalea Building
9920 - 108 Street
EDMONTON, Alberta

Dr. E. A. Babcock, Vice-President
Natural Resources Division
Alberta Research Council
Executive Offices
Terrace Plaza, 7th Floor
4445 Calgary Trail South
EDMONTON, Alberta

Dr. Peter Krahn
Director, Laboratory Services Branch
Occupational Health Services
Alberta Workers' Health, Safety & Compensation
2nd Floor, 10158 - 103 Street
EDMONTON, Alberta

Dr. P. Sims, Director
Research Management Division
Alberta Environment
14th Floor, Standard Life Centre
10405 - Jasper Avenue
EDMONTON, Alberta

Dr. R. S. Weaver
Executive Director
Alberta Environmental Centre
P.O. Bag 4000
VEGREVILLE, Alberta

*At March 31, 1984

1983-1984 FISCAL YEAR EXPENDITURES
(Thousands of dollars)

	Manpower	Supplies & Services	Grants	Fixed Assets	Total
Program Support	1138	872	5	636	2651
Plant Sciences	1037	211	9	379	1636
Chemistry	1906	632	0	389	2929
Animal Sciences	1482	606	0	330	2418
Environmental Technology	1004	344	20	474	1842
TOTAL	6569	2665	34	2208	11476

This is not an audited statement.

ORGANIZATION CHART